National Aeronautics
and Space Administration

February 9, 1998
NRA 98-OSS-02

RESEARCH ANNOUNCEMENT

FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER (FUSE) GUEST INVESTIGATOR PROGRAM

Cycle 1

Notices of Intent Due: April 9, 1998 **Proposals Due: May 8, 1998**

OMB Approval No. 2700-0087

FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER (FUSE)

GUEST INVESTIGATOR PROGRAM

Cycle 1

NASA Research Announcement
Soliciting Proposals for Basic Research

NRA 98-OSS-02

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Proposal Due Date: May 8, 1998

Office of Space Science
National Aeronautics and Space Administration
Washington, DC 20546-0001

FAR ULTRAVIOLET SPECTROSCOPIC EXPLORER
(FUSE)
GUEST INVESTIGATOR PROGRAM
Cycle 1

This NASA Research Announcement (NRA) solicits basic research proposals for participation in the National Aeronautics and Space Administration (NASA) program for space science observations and subsequent analysis of the resultant data from the Far Ultraviolet Spectroscopic Explorer (FUSE). The primary goal of the FUSE mission is the investigation of the nature and physics of interstellar and intergalactic gas through the use of high-resolution absorption spectroscopy of the far ultraviolet emission of distant sources.

FUSE is a Principal Investigator (PI)-class NASA mission. The FUSE PI, Dr. Warren Moos of Johns Hopkins University (JHU), is responsible to NASA for mission design, development, and operations. The FUSE PI is also responsible for achieving the mission's primary scientific objectives and has been granted a significant fraction of the observing time for this purpose. Consistent with the broad scientific objectives set for the mission, the PI is expected to consider tradeoffs in on-orbit performance and capabilities in order to keep the mission development within cost limitations set by NASA. With this higher risk approach, the scientific performance of the FUSE satellite may not be well known until it is characterized in orbit by the PI team. The FUSE mission is being developed in cooperation with Canada and France, who will share in the observing time.

Although FUSE is a PI-Class mission, the FUSE team explicitly proposed to NASA that a significant fraction of the FUSE observing time should be made available to the general astronomical community. The FUSE Guest Investigator (GI) Program is intended to enhance the scientific return from the mission and to allow a larger part of the astronomical community to use FUSE to conduct independent investigations.

FUSE is planned as a three-year mission. Approximately one third of the available observing time will be allocated to GI's in Cycle 1, one half in the second year, and two thirds in the third year. Approximately 2500 ksec of on-target exposure time will be available to GI's in Cycle 1. The time allocation is summarized in Appendix C. This NRA is the first announcement for the FUSE GI Program and solicits proposals only for Cycle 1 of the mission. The FUSE launch is currently scheduled for October 1998 aboard a Delta II rocket from Cape Canaveral Air Station. An In-Orbit Checkout (IOC) and Science Verification (SV) phase, lasting approximately two months, will follow launch. Cycle 1 is planned for the 12-month period following IOC and SV activities.

Participation in the FUSE GI Program is open to all categories of organizations, both domestic and foreign, including educational institutions, NASA Centers, profit and not-for-profit organizations, and other Government agencies. Proposals may be submitted at any time before the proposal due date. Late proposals will be held for the next review cycle. Scientists planning to propose are asked to submit a Notice of Intent in order to facilitate the timely selection of proposal review panels.

Proposals received in response to this NRA will be evaluated in a competitive scientific peer review conducted by NASA Headquarters, with a goal of announcing the selection approximately three months after the proposal due date. Proposals will be reviewed by panels organized by research area and/or topic. No budget is required with proposals at this time. Only after a proposal has been awarded observing time, based on scientific peer review, will a budget and institutional signature be required. A detailed schedule specifying proposal deadlines and important mission milestones is provided in Appendix C to this NRA.

Limited funds for awards under this NRA are expected to be available to investigators at U.S. institutions subject to the annual NASA budget cycle. The Government's obligation to make awards is contingent upon the availability of appropriated funds from which payment for award purposes can be made and the receipt of proposals which the Government determines are acceptable for award under this NRA. The total amount of funding available for the support of GI's for the present observing opportunity is anticipated to be approximately $1.2 million. It is anticipated that approximately 30 investigations will be recommended for selection. In most cases, investigations selected for award under this NRA will be funded through the use of grants.

Proposers whose investigations are awarded observing time will have proprietary use of their data for six months after receipt of the data in usable form, after which time the data will be placed in a public data archive that is accessible to other interested investigators.

Education and the enhancement of public understanding of space science are now considered vital and integral parts of all NASA space science missions and research programs. Therefore, NASA OSS encourages any U.S. proposer to this NRA to submit an optional Education/Public Outreach (E/PO) component with their research program in accordance with the guidelines in Appendix C.11. NASA has identified funds independent of the FUSE GI program to support E/PO activities in the Office of Space Science. Note that originality is not a criterion of such E/PO tasks; rather the important factor is that a tenable task of merit be proposed.

Further details relevant to the FUSE GI Program are included in the Appendices listed below. This NRA, its Appendices, and relevant reference documents may be downloaded directly via the World Wide Web at the addresses given below. Individuals not having access to the Internet may request paper copies of this Announcement and reference documents at the address given below.

Appendix A gives an overview of the mission and describes the observing opportunity. Appendix B gives the general instructions for responding to NASA Research Announcements. Appendix C, which supersedes and augments Appendix B, provides additional, NRA-specific information on the GI program, proposal submission and subsequent evaluation, selection, and implementation. Appendix D lists the targets reserved for the PI team for Cycles 1 and 2. Appendix E lists the calibration targets. Appendix F contains the abstracts describing the PI team observing programs.

Technical and reference documents are available interactively from the FUSE Science Center at JHU over the World Wide Web, for download via the World Wide Web or anonymous ftp, and in hard copy by request at the address given below. Of particular value is *The FUSE Observer's Guide,* which contains an overview of the mission capabilities, a detailed instrument description, and information about proposing for FUSE observing time (e.g., instructions for assessing feasibility, instrument summary, constraint summaries, exposure time calculations).

IDENTIFIER:	NRA 98-OSS-02
SUBMIT NOTICES OF INTENT TO PROPOSE **EITHER** TO:	Dr. George Sonneborn FUSE Project Scientist Laboratory for Astronomy and Solar Physics Code 681 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771 USA
OR ELECTRONICALLY TO:	sonneborn@stars.gsfc.nasa.gov
SUBMIT NOTICES OF INTENT BY:	April 9, 1998
PROPOSAL DUE DATE:	May 8, 1998
NUMBER REQUIRED:	12 printed copies **plus** Electronic submission of ASCII Proposal Form
SUBMIT ELECTRONIC PROPOSAL FORM TO:	fuse_prop@fusegi.gsfc.nasa.gov
SUBMIT PRINTED PROPOSALS TO:	FUSE Guest Investigator Program Laboratory for Astronomy and Solar Physics Code 681 Building 21, Room 114 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771 USA
POINT OF CONTACT FOR COMMERCIAL DELIVERY:	Dr. George Sonneborn TEL: 301-286-3665
SUBMIT EDUCATION/PUBLIC OUTREACH PROPOSALS TO:	<http://cass.jsc.nasa.gov/panel/>
SELECTING OFFICIAL:	Director Research Program Management Division Office of Space Science

OBTAIN ADDITIONAL INFORMATION ABOUT THE NRA FROM:	Dr. Hashima Hasan FUSE Program Scientist Office of Space Science Code SR National Aeronautics and Space Administration Washington, DC 20546-0001 USA TEL: 202-358-0377 FAX: 202-358-3097 E-mail: hashima.hasan@hq.nasa.gov
DIRECT SCIENTIFIC AND TECHNICAL QUESTIONS ABOUT THE FUSE GI PROGRAM AND REQUESTS FOR PRINTED APPENDICIES AND DOCUMENTATION TO:	Dr. George Sonneborn FUSE Project Scientist Laboratory for Astronomy and Solar Physics Code 681 Goddard Space Flight Center National Aeronautics and Space Administration Greenbelt, MD 20771 USA TEL: 301-286-3665 FAX: 301-286-1753 E-mail: sonneborn@stars.gsfc.nasa.gov
OBTAIN TECHNICAL INFORMATION ABOUT FUSE FROM:	Dr. Harold Weaver Department of Physics and Astronomy Johns Hopkins University Baltimore, MD 21218 USA TEL: 410-516-4251 FAX: 410-516-5494 E-mail: fuse_support@pha.jhu.edu

RETRIEVE NRA, APPENDICES, AND INSTRUCTIONS ELECTRONICALLY FROM:
<http://www.hq.nasa.gov/office/oss/> and select “Research Opportunities”
OR <http://fusewww.gsfc.nasa.gov/fuse/>

OBTAIN TECHNICAL INFORMATION ABOUT FUSE ELECTRONICALLY FROM:
<http://fuse.pha.jhu.edu/>

NASA appreciates your interest and cooperation in participating in the Far Ultraviolet Spectroscopic Explorer Guest Investigator Program.

Edward J. Weiler
Science Program Director
Astronomical Search for Origins
and Planetary Systems

APPENDICES

A. FUSE Mission Description

B. Instructions for Responding to NASA Research Announcements for Solicited Basic Research Proposals

C. Additional Information Regarding Proposal Preparation, Submission, Evaluation, Selection, and Implementation

D. FUSE PI Team Two-Year Reserved Target List

E. FUSE Calibration Target List

F. Abstracts for FUSE PI Team Observing Programs

G. Certifications

FUSE MISSION DESCRIPTION

A.1 Mission Overview

The Far Ultraviolet Spectroscopic Explorer (FUSE) is scheduled to be launched on a NASA Delta II rocket in October 1998 from the Cape Canaveral Air Station. FUSE will provide high-resolution ($\lambda/\Delta\lambda \geq 24{,}000$) spectroscopy at far ultraviolet (FUV) wavelengths (905-1195Å) of many astronomical objects in order to address fundamental questions related to the origin of the universe. The nominal mission duration is three years, with the possibility of an extension at the discretion of NASA. Launch will be followed by an approximately two month In-Orbit Checkout (IOC) and Science Verification (SV) period during which the instrument will be activated, tested, and calibrated. Cycle 1 commences after the IOC/SV phase and will be a 12-month period of mixed Principal Investigator (PI) team and Guest Investigator (GI) observations.

NASA has approved FUSE as a PI-class mission, in collaboration with the space agencies of Canada and France. The FUSE Principal Investigator, Dr. Warren Moos of Johns Hopkins University (JHU) in Baltimore, Maryland, is responsible to NASA for the mission design, development, and operations. The PI is also responsible for achieving the primary scientific objectives of the mission. Two major scientific programs have been identified as critical objectives to be carried out by the PI team:

1. Determine the abundance of deuterium in a variety of astrophysical environments, from the local interstellar medium to distant gas clouds along the lines of sight toward quasars and active galactic nuclei. The measurements will determine the extent to which stellar processing has modified the primordial abundance of deuterium, thereby providing a better understanding of the amount produced in the Big Bang and the subsequent chemical evolution of the universe. The deuterium measurements will also provide a direct means for estimating the baryonic content of the universe.

2. Measure the amount and distribution of the O VI ion in the Milky Way disk and halo and in the Magellanic Clouds, in order to probe hot gas in these galaxies that cannot be measured well via any other technique. Studying the distribution and kinematics of hot gas in galaxies will lead to a better understanding of how matter and energy are transferred in these galaxies.

Pending a full assessment of the instrument sensitivity in orbit, the PI team hopes to address a third major scientific objective:

3. Explore absorption by He II in the intergalactic medium (IGM) along the lines of sight to quasars at redshifts of 2 to 3. The necessary observations will be at the sensitivity limits of FUSE. They will help determine the mean opacity of the IGM, its variation with redshift, and attempt to resolve the He II Ly-alpha forest. These observations will also discriminate between discrete structures and distributed gas (the Gunn-Peterson effect) as sources of the He II opacity, and they will constrain the shape and origin of the ionizing UV background radiation.

The FUSE PI team will also conduct other complementary scientific programs. The list of PI-team reserved targets is included in Appendix D. Appendix F contains the abstracts for the PI team scientific programs. GI observations of PI reserved targets will not generally be allowed. A complete discussion of the policies regarding "protected" targets can be found in Section C.3.

The three programs described above comprise a large fraction of the total time allocated to the PI team (roughly 75% of the PI team's observing time and about half of the protected targets), which means that a wide variety of astronomical targets and scientific programs are available for GI investigations. The spectral window covered by FUSE permits the study of many astrophysically important atoms, ions, and molecules that cannot otherwise be investigated This wavelength range is extremely rich in spectral lines arising within the interstellar gas, the environment from which stars and planets form. The FUV spectral range also provides an opportunity to study many types of astrophysical objects, such as AGN's and quasars, massive stars, supernovae and their remnants, planetary nebulae, the outer atmospheres of cool stars, planets and their satellites, and comets. In their programs, GI's are encouraged to take full advantage of the unique capabilities of FUSE to address important problems in astrophysics.

Responding to this NRA constitutes Phase 1 of the FUSE GI proposal process. Information submitted during Phase 1 includes the scientific justification, observation descriptions, astronomical target data, exposure times, and any special requirements (e.g., orientation constraints, timing considerations, etc.). After selection by NASA, successful GI's will submit Phase 2 information to the FUSE Science Center at JHU so that detailed planning, feasibility assessment, and observation scheduling can be performed. Certain key information for both Phase 1 and Phase 2 must be submitted electronically, as further specified in Appendix C.

A.2 Instrument Description

FUSE will obtain spectra in the 905-1195 Å far-UV band with high resolving power ($\lambda/\Delta\lambda \geq$ 24,000) and high throughput. The effective area is expected to range from ~20 cm^2 to ~70 cm^2, depending on the wavelength. The high spectral resolution results from the use of high-line-density first-order diffraction gratings provided by France, which have been holographically ruled. The high throughput results from the use of an efficient optical design and reflective coatings optimized for wavelength coverage in the FUSE range. SiC coatings provide nearly constant reflectivity (~32%) across most of the FUSE range. At longer wavelengths ($\lambda \geq$ 1030 Å), Al+LiF coatings provide a reflectivity that is roughly twice that of SiC.

FUSE has four optical channels, each of which is fed by a separate off-axis parabolic mirror having a clear aperture of 39 cm x 35 cm. These mirrors serve as the primary mirrors for four co-aligned telescopes, all of which simultaneously view the same astronomical field at the same magnification. A Focal Plane Assembly (FPA) is at the focus of each mirror and consists of a flat mirror mounted on a precision two-axis micromotion stage. Three slits are cut into the mirror, as given in Table A-1.

Table A-1: FUSE Aperture Sizes and Expected Throughput and Spectral Resolution

Aperture	Acronym	Dimensions (arcsec)	Point Source Throughput	Spectral Resolution ($\lambda/\Delta\lambda$)
High Resolution	HIRS	1.25 x 20	0.67	~24,000 (point source)
High Throughput	MDRS	4 x 20	0.98	~24,000 (point source)
Large Square	LWRS	30 x 30	1.00	3,000 (diffuse source)

Use of the HIRS aperture ensures that maximum spectral resolution is maintained even if the telescope imaging and pointing is worse than expected. The MDRS slit has a higher throughput and should provide a spectral resolving power of ~24,000 if the telescope image quality and pointing stability meet their specifications. The LWRS aperture will be used to aid in coarse alignment of the channels and can also be used for scientific observations of extended objects when high spectral resolution is not required. The slit throughputs and spectral resolutions shown in Table A-1 are computed assuming that the telescope point-spread function and pointing stability are within specifications.

The slits form the entrance apertures for Rowland spectrographs. The spectrograph gratings disperse and refocus the incoming light onto two 2-dimensional delay-line microchannel plate (MCP) detectors. Two of the optical channels (one LiF and one SiC) feed one detector, the other LiF and SiC channels feed the other detector. The entire wavelength range is simultaneously covered on each detector by combining data from two of the optical channels; the channel having SiC-coated optics covers 905-1100 Å and the channel having LiF-coated optics covers 1000-1195 Å. The resulting spectral images are highly astigmatic, and spatial resolution of limited quality is available only at a few specific wavelengths, where the astigmatism is minimized.

Each detector segment is formatted into 16,384 x 1024 analog pixels, but these data are rarely viewed as full resolution two-dimensional images. At low source count rates (<1200 counts/sec), data are stored in time-tag mode (TTAG): the detector segment, position, and pulse height of each photon event are recorded. At high count rates, data are accumulated in histograms onboard (HIST mode). Absolute timing pulses are inserted into the TTAG data stream periodically at a user-specified rate between 8 Hz and 0.01 Hz, so that photon arrival times can be estimated.

For the two optical channels using Al+LiF coatings, light that does not pass through the slits is reflected into a Fine Error Sensor (FES) CCD camera provided by Canada that has a 21x21 arcmin field of view. This FES is used for initial target star field acquisition and for aiding in pointing control. The positions of guide stars in the FES field of view are sent to the spacecraft's attitude control system, which provides pointing stability to <0.5 arcsec (1σ).

Further details on the FUSE instrument can be found at the JHU FUSE Science Center web site at <http://fuse.pha.jhu.edu/>. Paper copies of documentation can be obtained from the NASA Project Scientist at the address given in the Cover Letter to this NRA.

A.3 Satellite Operations and Observation Planning

FUSE is expected to be inserted into a nearly circular orbit with an altitude of ~775 km, an orbital inclination of ~25°, and an orbital period of ~101 minutes. The plane of the orbit precesses with a period of ~60 days. FUSE will be controlled from the Satellite Control Center located on the campus of Johns Hopkins University through a single ground station antenna located at the University of Puerto Rico in Mayaguez. Typically, the FUSE spacecraft will be in contact with the ground station for 10-12 minutes per orbit for about seven consecutive orbits, followed by eight orbits (~12 hours) with no contact. Therefore, virtually all FUSE observations will be conducted autonomously via stored commands. The FUSE Project estimates that 2000 seconds per orbit, on average, will be available for exposure time on the target.

The beta angle is the angle between the anti-Sun direction and the telescope boresight, and is normally restricted to values between 15° and 105°. Limited observations outside this beta angle range may be considered in future cycles if experience with the spacecraft indicates their feasibility provided they do not severely impact mission operations. The absolute beta angle limits are 0° to 135°.

Since the instrument produces spectra with very limited spatial information, the primary reason for observing at specific roll angles will be to avoid having other nearby stars fall in the 20 arcsec long slit or to place the long axis of the slit at a particular orientation. If certain slit orientations are required, then the observations must be obtained at fixed times during the year when the roll angle of the satellite satisfies the required slit orientation. Because of power constraints, the satellite cannot be oriented with the plane of the solar arrays more than 15° from the normal to the sun line.

Due to the single ground station and the limited onboard data storage capacity, memory for spectral data is a resource that must be managed to facilitate efficient operations. Therefore, the ability to obtain large numbers of observations of bright targets in a short period of time (e.g., consecutive orbits) is very limited due to memory and downlink constraints.

Following submission of the detailed observing plan for proposals selected through this NRA, a Long-Range Plan (LRP) will be generated with a duration of about six months. All objects in a target database will be candidates for scheduling in the LRP. A software planning tool is used to optimize the schedule by assigning "bins" (~one-week intervals), during which specific observations should be executed. After the LRP defines the global observing plan, a Short-Term Schedule (STS) is constructed for each LRP bin. The STS specifies a detailed, time-ordered sequence of orbit-by-orbit activities and events to be executed on the satellite. The LRP's and STS's continually evolve with time in order to accommodate changing conditions. However, due to the complexity of the scheduling process, changes to the submitted observing plan require strong scientific justification.

A.4 Data Processing and Calibration

The scientific data from FUSE observations consist of the FUV spectral data, as well as the optical CCD images from the FES. Observers will receive both data sets and related calibration files in FITS format with binary extensions.

While the raw FUV data are two-dimensional, there is little spatial information available along the slit due to astigmatism in the spectrograph. Therefore, the primary product of the reduction process will be extracted, calibrated, one-dimensional spectra. The spectral extraction will include all of the astigmatic spectral image so as to achieve the highest possible spectral resolution and sensitivity.

Each exposure on a target produces independent SiC and LiF spectra on each of four detector segments (two segments for each FUSE detector) for a total of eight separate spectra for each observation. Objects observed in TTAG mode for 2000 sec will produce raw data files ranging in size from 208 KB per segment (for faint objects at the background limit) to 7.8 MB per segment (for count rates at the 1200 count/sec limit for TTAG mode). Standard HIST mode observations result in raw data files that are ~2.7 MB per segment. In order to minimize Doppler smearing in HIST mode due to the orbital motion of the satellite, up to four exposures per orbit are expected. Thus, HIST mode can produce 42.5 MB of data per orbit. A calibrated one-dimensional spectrum occupies 229 KB, so a total of 1.8 MB is required for the eight one-dimensional target spectra. In addition to the eight separate object spectra, corresponding sky spectra will also be extracted, for a total of 16 one-dimensional spectra per observation.

FUSE data are processed in a modified version of the “pipeline” process used for the reduction of Hubble Space Telescope data. The FUSE pipeline screens the data to remove and/or flag low quality or unreliable data, corrects for electronic drifts and geometrical distortions of the analog detector pixels, corrects for the Doppler motion of the spacecraft, straightens the curvature of the astigmatic spectral image, subtracts background and applies a flat-field correction, optimally extracts the one-dimensional spectra, and applies wavelength and flux calibrations to the extracted spectra. FES images are also processed to subtract bias and dark levels, apply a flat-field correction, and apply an approximate flux calibration.

Wavelength calibration provides a mapping of pixel coordinates into wavelength. The absolute wavelength accuracy on FUSE is expected to be ~5 km s^{-1} when using the HIRS slit and better than 10 km s^{-1} when using the MDRS slit. Since there is no onboard calibration lamp, the wavelength calibration will be obtained from observations of astronomical sources. Bright stars with interstellar molecular hydrogen and atomic absorption lines will map the high-order variations in the wavelength scale. The zero point will be set and monitored through observations of emission-line objects and airglow features.

The FUSE photometric calibration is expected to have an absolute accuracy of 10% and an rms relative uncertainty of no more than 5%. The basic photometric calibration will be defined by models of hot DA white dwarfs. The model parameters will be determined by fits to high signal-to-noise spectra obtained at visible wavelengths. The flat-field calibration corrects for changes in sensitivity that depend on the physical location of the photon event on the detector. Observations of onboard lamps and the relatively smooth spectra of DO white dwarfs and sdO stars will be used, in conjunction with ground calibration data, to determine flat-field corrections.

Each of the eight independent channels described above must be calibrated separately. Since there are three possible slits for any given observation, each of which illuminates different regions of the detector, up to 24 different sets of calibration files may be required. While all slits in each channel will be calibrated to some degree, they may not all be calibrated with the same precision nor monitored with the same frequency. The FUSE Project plans to define a few observational modes, having the best characterized calibrations, that will satisfy the requirements for the vast majority of scientific investigations.

FUSE data formats will be compatible with many readily available astronomical software packages that can be easily adapted by observers according to their preferences for viewing the raw and calibrated data. Many readily available software tools can also be used for the measurement and analysis of the calibrated one-dimensional spectra.

The FUSE data archive will be located at the Space Telescope Science Institute (STScI). Access procedures for proprietary and public data will be similar to those for HST data. Only the PI of each GI program (and their designees) will have access to that program’s data during the proprietary period. After the proprietary period, the FUSE data become publicly available. Access to and distribution of FUSE data are generally expected to be through electronic transfer from the FUSE archive. Calibration observations will be available from the archive as soon as possible. See Appendix C for additional information about FUSE data rights.

Further details on FUSE science data processing and calibration are given in the *FUSE Observer’s Guide* at the JHU FUSE Web site <http://fuse.pha.jhu.edu/>.

INSTRUCTIONS FOR RESPONDING TO NASA RESEARCH ANNOUNCEMENTS

Part 1852.235-72
NASA Federal Acquisition Regulations (FAR) Supplement (NFS)
Version 89.90, Effective March 11, 1997.

Accessible at URL
<http://www.hq.nasa.gov/office/procurement/regs/nfstoc.htm>,
open Part 1852.228 to 1852.241 from menu.

(JANUARY 1997)

A. General.

(1) Proposals received in response to a NASA Research Announcement (NRA) will be used only for evaluation purposes. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a preaward synopsis published for individual proposals.

(2) A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

(3) NRA's contain programmatic information and certain requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRA's.

(4) A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded in response to an NRA. NASA will determine the appropriate instrument. Contracts resulting from NRA's are subject to the Federal Acquisition Regulation (FAR) and the NASA FAR Supplement (NFS). Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NPG 5800.1).

(5) NASA does not have mandatory forms or formats for responses to NRA's; however, it is requested that proposals conform to the guidelines in these instructions. NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.

(6) To be considered for award, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to

permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation.

B. NRA-Specific Items. Several proposal submission items appear in the NRA itself: the unique NRA identifier, when to submit proposals, where to send proposals, number of copies required, and sources for more information. Items included in these instructions may be supplemented by the NRA.

C. Proposal Content. The following information is needed to permit consideration in an objective manner. NRA's will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

(1) *Transmittal Letter or Prefatory Material*.

(i) The legal name and address of the organization and specific division or campus identification, if part of a larger organization;

(ii) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press;

(iii) Type of organization: e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.;

(iv) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation;

(v) Identification of other organizations that are currently evaluating a proposal for the same efforts;

(vi) Identification of the NRA, by number and title, to which the proposal is responding;

(vii) Dollar amount requested, desired starting date, and duration of project;

(viii) Date of submission; and

(ix) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization(unless the signature appears on the proposal itself).

(2) *Restriction on Use and Disclosure of Proposal Information*. Information contained in proposals is used for evaluation purposes only. Offerors or quoters should, in order to

maximize protection of trade secrets or other information that is confidential or privileged, place the following Notice on the title page of the proposal and specify the information subject to the notice by inserting an appropriate identification in the Notice. In any event, information contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the Notice.

Notice

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract(or other agreement) is awarded on the basis of this proposal, the Government shall have the right to use and disclose this information (data) to the extent provided in the contract(or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(3) *Abstract.* Include a concise (200-300 word if not otherwise specified in the NRA) abstract describing the objective and the method of approach.

(4) *Project Description.*

(i) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance, relation to the present state of knowledge, and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the plan of work, including the broad design of experiments to be undertaken and a description of experimental methods and procedures. The project description should address the evaluation factors in these instructions and any specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Subcontracting significant portions of a research project is discouraged.

(ii) When it is expected that the effort will require more than one year, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

(5) *Management Approach.* For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and arrangements for ensuring a coordinated effort should be described.

(6) *Personnel.* The principal investigator is responsible for supervision of the work and participates in the conduct of the research regardless of whether or not compensated under the award. A short biographical sketch of the principal investigator, a list of principal publications, and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(7) *Facilities and Equipment.*

(i) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any Government-owned facilities, industrial plant equipment, or special tooling that are proposed for use. Include evidence of its availability and the cognizant Government points of contact.

(ii) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for research and non research purposes should be explained.

(8) *Proposed Costs*.

(i) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages, fringe benefits, equipment, expendable materials and supplies, services, domestic and foreign travel, ADP expenses, publication or page charges, consultants, subcontracts, other miscellaneous identifiable direct costs, and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all staffing data in terms of staff-months or fractions of full-time.

(ii) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired, purpose and estimated number and lengths of trips planned, basis for indirect cost computation(including date of most recent negotiation and cognizant agency), and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases.

(iii) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 1831(and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

(9) *Security*. Proposals should not contain security classified material. If the research requires access to or may generate security classified information, the submitter will be required to comply with Government security regulations.

(10) *Current Support*. For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

(11) *Special Matters*.

(i) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.

(ii) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

D. Renewal Proposals

(1) Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. A renewal proposal should not repeat all of the information that was in the original proposal. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the research are expected to be covered during the period for which support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.

(2) NASA may renew an effort either through amendment of an existing contract or by a new award.

E. Length. Unless otherwise specified in the NRA, effort should be made to keep proposals as brief as possible, concentrating on substantive material. Few proposals need exceed 15-20 pages. Necessary detailed information, such as reprints, should be included as attachments. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments.

F. Joint Proposals.

(1) Where multiple organizations are involved, the proposal may be submitted by only one of them. It should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.

(2) Where a project of a cooperative nature with NASA is contemplated, describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. The proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

G. Late Proposals. A proposal or modification received after the date or dates specified in an NRA may be considered if doing so is in the best interests of the Government.

H. Withdrawal. Proposals may be withdrawn by the proposer at any time before award. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

I. Evaluation Factors

(1) Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.

(2) Evaluation of a proposal's relevance to NASA's objectives includes the consideration of the potential contribution of the effort to NASA's mission.

(3) Evaluation of its intrinsic merit includes the consideration of the following factors of equal importance:

(i) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.

(ii) Offeror's capabilities, related experience, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

(iii) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel critical in achieving the proposal objectives.

(iv) Overall standing among similar proposals and/or evaluation against the state-of-the-art.

(4) Evaluation of the cost of a proposed effort may include the realism and reasonableness of the proposed cost and available funds.

J. Evaluation Techniques. Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases, proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house, others are evaluated by a combination of in-house and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. The final decisions are made by a NASA selecting official. A proposal which is scientifically and programmatically meritorious, but not selected for award during its initial review, may be included in subsequent reviews unless the proposer requests otherwise.

K. Selection for Award.

(1) When a proposal is not selected for award, the proposer will be notified. NASA will explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.

(2) When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation. The contracting officer may request certain business data and may forward a model award instrument and other information pertinent to negotiation.

L. Cancellation of NRA. NASA reserves the right to make no awards under this NRA and to cancel this NRA. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation.

(End of provision)

Additional Information Regarding Proposal Preparation, Submission, Evaluation, Selection, and Implementation

The information contained in Appendix C augments and supersedes Appendix B and applies only to this NRA.

Proposal Submission Summary

1. Retrieve the NRA, Appendices, LaTeX Proposal Form and instructions from the FUSE GI web site <http://fusewww.gsfc.nasa.gov/fuse/>. See Section C.5.
2. Proposers are requested to submit a Notice of Intent to Propose by April 9, 1998. See Section C.6.
3. Submit 12 printed copies of the complete proposal and the electronic FUSE Proposal Form by May 8, 1998. Complete instructions and postal and electronic addresses are given in Section C.7.

C.1 Guest Investigator (GI) Program Description

C.1.1 Overview

Under this NRA, NASA seeks a scientifically meritorious and diverse GI program for the FUSE mission. GI's are encouraged to submit proposals that exploit the unique capabilities of FUSE to the maximum extent possible, but the content and scope of GI programs must be consistent with the broad observing guidelines discussed below.

NASA has allocated approximately half of the mission's observing time (over three years) to the PI team with which they will address certain high-priority scientific problems described in Appendix A. The targets reserved for two years by the PI team are listed in Appendix D and the abstracts of the PI team's observing programs may be found in Appendix F. There are no protected science investigations, only reserved targets. These targets are reserved for all science investigations consistent with the exposure times listed in Appendix D. The scientific goals of GI proposals may overlap with those of the PI team so long as different targets are observed. However, see Section C.3.4 for policies concerning solar system targets. The policies concerning FUSE targets are summarized in Section C.3.

NASA plans to allocate about one third of the FUSE observing time in Cycle 1 to GI programs, about one half in Cycle 2, and about two thirds in Cycle 3 (see Section C.1.2). GI observing time on FUSE will be available to the international astronomical community through peer-reviewed proposals. An In-Orbit Checkout (IOC) and Science Verification (SV) phase, lasting approximately two months, will follow launch. Cycle 1 is planned for the 12-month period following IOC and SV activities. NASA anticipates that future observing cycles will also have 12-month durations.

There are two types of unscheduled observing time that can be made available with the approval of the FUSE Project Scientist. The first deals with major targets of opportunity (TOO), such as supernovae, novae, cataclysmic variables in outburst, and comets (see Section C.1.5). The second type, called Project Scientist's Discretionary Observing Time, is intended for observations of an urgent nature requiring a small amount of observing time and are of sufficiently high scientific priority that the observation should not be delayed to the next observing cycle (see Section C.1.6).

FUSE observing time in Cycle 1 will be allocated in on-target exposure time in kiloseconds. GI's should request only the time needed for scientific exposures. After providing time for target acquisition, satellite maneuvering, and operational overhead, it is estimated that ~2500 ksec of on-target exposure time will be allocated to GI programs in Cycle 1. Observing time for PI team observations have been allocated in the same manner.

Experience with previous far ultraviolet space missions indicates that the sensitivity of FUSE may decline significantly with time, possibly due to exposure to the space environment or from contamination produced by outgassing from the satellite itself. Any sensitivity degradation would most adversely affect the scientific objectives on faint objects, whereas programs on bright objects should still be feasible in subsequent observing cycles, even if instrument throughput is lower than expected. Therefore, NASA envisions that the vast majority of the available GI observing time during the first cycle will be allocated to observations of faint objects in order to take advantage of the higher instrument sensitivity expected during the early phase of the mission.

As discussed further in section C.3.1, there are specific constraints that apply to observations of bright targets and observations that require high signal-to-noise ratios. FUSE has very high gain detectors, which decreases their expected lifetime by a large factor compared, for example, to that of the UV detectors in the Space Telescope Imaging Spectrograph. The amount of charge extracted from the FUSE detectors is a limited resource that will be managed during the course of the mission. Consequently, observations of bright targets and targets requiring high signal-to-noise ratios, including calibration targets, may be restricted to ensure that the primary mission objectives are achieved.

Due to the difficulties associated with administering many very small programs, **each Cycle 1 FUSE GI proposal must request a minimum of 10 ksec of on-target exposure time**. If the proposal has only one target, the exposure time on that object must be at least 10 ksec. A proposal having multiple targets can have exposure times of less than 10 ksec per target, as long as the total exposure time for the proposal is at least 10 ksec. Note, however, that if a target has an exposure time less than 2 ksec (≤1 orbit), the program will be charged 2 ksec for that target to account for the extra overhead associated with short-duration observations. The FUSE Project expects that the satellite will execute two to three pointing maneuvers per day, on average, implying that the average exposure time will be ~10 ksec. The FUSE Project plans to support programs to monitor specific targets and programs requiring time-critical observations. See the *FUSE Observer's Guide* at the FUSE Science Center web site <http://fuse.pha.jhu.edu/> for details.

NASA envisions that ~75% of the time allocated to GI's in Cycle 1 will be for large observing programs that require total on-target exposure time of at least 100 ksec. The balance would be allocated to smaller programs. Proposers may only request observations to be executed during the nominal 12-month period of Cycle 1.

It is NASA's intent that all approved regular (i.e., non-TOO) observing programs be executed. Therefore, regular observing programs will be carried over into Cycle 2 if they are not executed during the current NRA period. GI's need not repropose for these observations. Any such programs will be given priority for execution in Cycle 2. However, TOO programs will not be carried over into Cycle 2. GI's must repropose any TOO programs that are not activated and executed within the nominal one-year observing cycle.

C.1.2 Observing Time Allocation

NASA has allocated the FUSE observing time as shown in Table C-1. This table is based on 5200 orbits per year. There will be a single scientific peer review for all GI proposals. Proposals for Canadian and French GI time will be reviewed and selected in the same manner as other GI proposals. Although the observing time allocations in the table are expressed in orbits, individual proposals are awarded time in on-target exposure time (ksec) not including time for target acquisition, maneuvering, and operational overhead. There is expected to be ~2000 sec of on-target exposure time per orbit.

Table C-1. FUSE Observing Time Allocation

	First Year		Second Year		Third Year	
	%	No. Orbits	%	No. Orbits	%	No. Orbits
PI Team	60%	3120	40%	2080	25%	1300
France (PI + GI)	5%	PI 155 GI 105	5%	PI 95 GI 165	5%	PI 65 GI 195
Canada (GI)	5%	260	5%	260	5%	260
U.S. and other GI	25%	1300	45%	2340	60%	3120
Calibration	5%	260	5%	260	5%	260

C.1.3 Availability of Mission Capabilities during Cycle 1

The rapid development schedule for FUSE in the PI-class mission mode may result in greater uncertainty in the on-orbit performance of the FUSE satellite at the start of the mission. While FUSE was designed to deliver capabilities for a wide range of observing programs, its design, development, and initial testing have been optimized for absorption spectroscopy of isolated point sources. During IOC/SV, priority will be given to achieving efficient nominal operations of fairly simple observing programs (e.g., isolated point sources). GI and PI team observations that require more sophisticated capabilities (e.g., blind offsets, crowded fields, diffuse or extended objects, brighter targets, moving targets, etc.) will be attempted as experience permits. The same caution applies to the availability of optimized instrument performance (e.g., the highest possible spectral resolution, signal-to-noise ratio, etc.). Prospective GI's must keep in mind these limitations when developing their scientific objectives and designing their observing programs to propose for the first year of operations covered by this Cycle 1 NRA.

C.1.4 Data Rights

Data rights for PI and GI observations will reside solely with their respective proposers for a period of six months following delivery of the processed data. After this period, the data become available for public access through the FUSE data archive.

The FUSE Project intends to release processed calibration data as soon as possible. If a calibration target listed in Appendix E is also a PI or GI target, the FUSE Project Scientist will consult with the observer to determine the most appropriate release date. The calibration target list will probably be modified prior to the release of the NRA for future observing cycles. The FUSE Project may use any FUSE observation to assist in assessing the performance of the instrument, but the confidentiality of data obtained for PI or GI scientific programs will be maintained.

C.1.5 Proposals for Targets of Opportunity

Proposals for major targets of opportunity (TOO), such as supernovae, novae, cataclysmic variables in outburst, and comets, etc. will be supported in Cycle 1. Scientists wishing to observe such targets should prepare and submit proposals according to the following sections of this Appendix**. Note that a proposal must not contain a mixture of TOO targets and non-TOO targets.** Target of opportunity status should be noted in the Special Requirements section of the proposal. The proposals will be reviewed in the regular review cycle, and successful proposals will be approved but will not be allocated specific amounts of observing time. (However, the review panels may recommend a maximum amount of observing time that should be allocated to a given TOO program.)

The lack of real-time observing capability constrains the speed with which a TOO observation can be implemented. The planned TOO response time is ~48 hours. It will be the GI's responsibility to notify the FUSE Project Scientist and the FUSE Science Center at JHU when any approved opportunity has occurred. The Project Scientist will consult with the GI, the FUSE PI, and other members of the FUSE Project to determine the feasibility of observing the particular event and the impact of disrupting ongoing observations before deciding whether or not to activate the TOO program and approve the observation.

C.1.6 Discretionary Observing Time

Project Scientist's Discretionary Observing Time is intended for observations of an urgent nature for which no approved observing program exists, that can be accomplished with a small amount of observing time, and are of sufficiently high scientific merit and priority that they should not be delayed to the next observing cycle. The total amount of Discretionary Observing Time in Cycle 1 is extremely limited. The FUSE Project Scientist may approve Discretionary Observing Time in those cases where the scientific timeliness of the project is such that it should be done quickly, the need for the observation could not have been foreseen and proposed for in the current observing cycle, and it does not duplicate or infringe on approved GI or PI team programs. A proposal for Discretionary Observing Time may be submitted to the Project Scientist in the form of a letter and should describe the observations and their feasibility and scientific objectives and explain why Discretionary Time should be granted in lieu of consideration during the next proposal cycle. All requests for Discretionary Time will be reviewed for scientific merit and technical feasibility.

C.1.7 Users' Committee

A User's Committee will be formed by the Project Scientist after the selection of successful proposals is announced. Committee membership will be drawn from the names of PI's for Cycle 1 GI programs. The Committee will meet periodically each year to advise the Project Scientist on matters concerning the FUSE GI program.

C.2 Proposal Preparation

C.2.1 General Guidelines

Proposals may be submitted at any time before the proposal due date. Late proposals will be held for the next review cycle. Proposers are urged to submit a Notice of Intent to Propose (see NRA cover letter and Section C.6) in order to facilitate the timely selection of peer review panels. Note that Notices of Intent are not required in order to propose for the FUSE GI program. Proposals received in response to this NRA will be evaluated in a competitive scientific peer review conducted by NASA Headquarters, with a goal of announcing the selection approximately three months after the proposal due date. Proposals will be reviewed by panels organized by research area. Budgets should **not** be submitted with Phase 1 proposals. Only after a proposal has been accepted by NASA based on its scientific merits will a budget and institutional signature be required from PI's at U.S. institutions.

Submission of proposals in response to this NRA has two components: (1) a FUSE Phase 1 Proposal Form must be completed and submitted electronically, and (2) the requisite number of printed copies of the complete proposal must be submitted to the address given below. The Phase 1 Proposal Form is an ASCII LaTeX file that allows the proposer to supply certain information for a set of keywords. Some keywords are required (e.g., PI name, total amount of observing time requested) and some are optional (e.g., special requirements). For those proposers familiar with LaTeX, the Proposal Form may also be used to format the final printed proposal. Electronic submission of the LaTeX Proposal Form is required of all proposers, since this file will be parsed into a database to support the proposal review. Proposers without access to electronic mail should consult with the FUSE Project Scientist to discuss proposal submission. Since the forms are in ASCII format, proposers can edit the files using the text editor of their choice.

C.2.2 Who May Propose

Participation in the FUSE GI Program is open to all categories of organizations, both domestic and foreign, including educational institutions, NASA Centers, profit and not-for-profit organizations, and other Government agencies. Each FUSE GI proposal must identify a single Principal Investigator (PI) who assumes full responsibility for the conduct of the scientific investigation.

Following selection by NASA, the FUSE Science Center at JHU will communicate formally only with the PI of each program, or his/her designee. It is this person's responsibility to provide JHU with the Phase 2 data defining each exposure in a timely manner and to respond to any questions concerning observational constraints or configurations.

C.2.3 Canadian and French Observing Time

As part of their participation in and contribution to the FUSE mission, Canada and France each receive a minimum of 5% of the mission's observing time as defined in Letters of Agreement between NASA and the respective space agencies. Most of this time will be selected competitively via the GI proposal peer review process described in this NRA. Scientists at Canadian and French institutions should follow the instructions in this Appendix for proposal preparation and submission. Note, however, that an institutional endorsement of the type described in the following section is not required for Canadian and French proposals submitted in response to this NRA.

C.2.4 Guidelines for Other non-U.S. Participation

NASA welcomes proposals from investigators at institutions and organizations outside the U.S. in response to this NRA. However, these investigators are not eligible for NASA funding. Proposals from institutions and organizations outside the U.S., and U.S. proposals including significant non-U.S. participation, must be endorsed by the funding or sponsoring institution or respective government agency in the country in which the proposal originates. Such endorsement should indicate that the proposal merits careful consideration by NASA, and that, if selected, sufficient support will be made available to undertake the proposed research.

In addition to submitting the electronic Proposal Form and the printed proposal as described in the NRA Cover Letter and Section C.6, one copy of the proposal along with the Letter of Endorsement from the sponsoring non-U.S. institution or agency should be forwarded to:

Ms. Bettye Jones
Ref: NRA 98-OSS-02
Space Science and Aeronautics Division
Code IS
NASA Headquarters
Washington, DC 20546-0001
USA

All proposals must be typewritten in English. All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S. All proposals, including those with or without non-U.S. participation, must follow all other guidelines and requirements described in this NRA.

All proposals must be received on or before the established closing date. Those received after the closing date will be treated in accordance with NASA's provisions for late proposals. Sponsoring non-U.S. institutions and agencies may, in exceptional situations, forward a proposal without endorsement to the Space Science and Aeronautics Division, if endorsement cannot be obtained before the announced closing date. In such cases, however, NASA's Space Science and Aeronautics Division should be advised as to when a decision on endorsement can be expected.

Successful and unsuccessful proposers will be notified directly by the NASA Research Program Management Division. Copies of these letters will be sent to the sponsoring institution or government agency. Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Space Science and Aeronautics Division will arrange with the non-U.S. sponsoring agency for proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging their respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

1. A letter of notification by NASA; and/or
2. An exchange of letters between NASA and the sponsoring governmental agency.

C.2.5 Proposal Format and Content

Proposals submitted in response to this NRA constitute Phase 1 of a two-stage process. Phase 1 provides the scientific justification and feasibility analysis, which is the basis for selection by

NASA. Phase 2, in which only proposers awarded observing time by NASA participate, provides the FUSE Science Center with the detailed definition of each observation to be executed for the program.

Each proposal submission has two parts: a) 12 printed copies of the proposal and b) a Phase 1 LaTeX Proposal Form that must be submitted electronically. Instructions for obtaining the Proposal Form are given in Section C.5. Submission procedures are described in Section C.7.

The Phase 1 Proposal Form defines a number of sections, or subject areas, including the target list and exposure times, that must be addressed in each proposal. These sections are listed below and should be presented in the proposal in the order indicated (provided automatically by the Proposal Form). Proposals must be concisely written. The length of each section of the proposal should not exceed the page limits indicated below, using single-spaced pages 8.5" (21.6 cm) by 11" (27.9 cm) or A4 format paper with 1" (2.5 cm) margins. Proposals must be printed with a font size no smaller than 11 points. This sentence uses 11 point type.

Reviewers will be instructed to base their review on only the portion of each proposal that complies with the page limits given in this NRA.

The Cover Page of the proposal must provide the:

- Proposal title
- PI name, institution, mailing address, telephone and facsimile number, and electronic mail address
- Total requested exposure time in kiloseconds
- Total number of targets
- Scientific category (see below)
- Abstract – a brief descriptive summary of the proposal (200 words or less). Note that the abstracts of successful proposals will be made available online, so they should not contain proprietary or confidential information.

Either the Cover Page or the second page of the proposal must list the following information for each Co-Investigator (Co-I):

- Name, institution, country

Scientific Category – Each proposal must identify one of nine primary research areas. The scientific category assigned by the proposer will guide assignment of the proposal to the appropriate scientific review panel. The nine research areas (and some examples) are:

1. Solar system objects (planets, satellites, comets)
2. Cool stars (single and noninteracting binary systems)
3. Hot stars (O, B, and Wolf-Rayet stars, white dwarfs, central stars of planetary nebulae, including hot stars in the Magellanic Clouds)
4. Interacting binary systems (RS CVn systems, cataclysmic variables, symbiotic stars, mass-transfer binaries)

5. Stellar ejecta and gaseous nebulae (circumstellar material, H II regions, planetary nebulae, supernova remnants, novae, supernovae)
6. Interstellar medium and galactic structure: (interstellar gas and dust, diffuse Galactic emission, Galactic halo, gas and dust in the Magellanic Clouds)
7. Galaxies and extragalactic stellar populations (excluding the Magellanic Clouds)
8. AGN and quasars
9. QSO absorption lines and the intergalactic medium

Proposal Sections – The proposal must contain the following sections and be addressed in the order indicated for each proposed observing program. The page length limits are indicated.

1. *Scientific Justification (three pages)* – Fully describe the scientific objectives of the proposed investigation, clearly stating its goals, its significance to astronomy, and why FUSE data are essential to the investigation. All text, figures, tables, and references must not exceed this three-page limit.

2. *Feasibility and Safety (two pages)* – The proposed program must justify the need for the requested exposure time for each target, noting the required signal-to-noise ratio (S/N) and spectral resolution, expected flux and any other information relevant to the observation (e.g., wavelength region of interest, spectral flux distribution, emission line intensities). This section forms the basis for technical assessment of the feasibility of the proposed observations. Describe the basis for and accuracy of your flux estimates, including any extrapolations into the FUSE spectral range that have been made.

3. *Description of Observations (one page)* – Describe the observations. All special requirements (e.g., target of opportunity, monitoring program, specific aperture orientation) must be summarized and justified. These encompass any information affecting the scheduling of the target, such as pointing constraints (e.g., spacecraft roll, time constraints), scheduling constraints (e.g., coordinated observations, phase coverage, contiguous observations), Targets of Opportunity, and moving targets. Ephemeris data for solar system targets is not required in the Phase 1 proposal.

4. *Additional Information (one page)* – This section may be used to provide any relevant information concerning data analysis plans, modeling capabilities, plans for supporting observations to be conducted using other telescopes, etc.

5. *Principal Investigator and Co-Investigator Biographical and Publication Data (one page)* – An abbreviated biographical sketch for the PI should be provided and include a list of the most recent refereed publications relevant to the scientific proposal. Additional biographical or publication data may be provided for any of the Co-I's the PI wishes to include. All material must fit within the one-page limit.

Proposed Target List – Each proposal must include a table of the proposed targets for observation. This table should include all the requested target and exposure information and parameters described in the instructions for the Phase 1 Proposal Form. Proposers are strongly encouraged to use the LaTeX Proposal Form to prepare this formatted table of targets and exposure times. In all cases, these data must also be submitted electronically using the FUSE LaTeX Proposal Form.

C.3 Targets For Observation

This NRA primarily seeks to identify new targets for observation with the FUSE satellite. Appendix D lists the targets reserved by the PI team for Cycles 1 and 2, amounting to 80% of the total time allocated to the PI team. In order to provide for the needs of both the PI team and GI programs, the PI team may reserve any given target for a maximum of two cycles. A target reserved for Cycles 1 and 2 may not also be reserved for Cycle 3. This policy allows the PI team to design the large observing programs outlined in Appendix A, but does not lock up individual targets for the entire three-year mission. The PI team will have an opportunity to update its reserved target list before the NRA's for Cycles 2 and 3 are issued.

C.3.1 Bright Objects and Detector Performance Limitations

Given the expected sensitivity of the FUSE instrument, bright targets in the far ultraviolet present a particular challenge to the mission. Sufficiently high local count rates may damage the microchannel plates (MCP's), and there is also a limited amount of charge that can be extracted from the MCP's during their lifetime. Throughout the mission, the remaining lifetime of the detectors must be managed to maintain faint-object sensitivity so that FUSE can complete its primary scientific objectives. It is, therefore, necessary to restrict observations of UV-bright targets.

A detailed description of the bright limit can be found in the *FUSE Observer's Guide*. **The FUSE Project will not support Cycle 1 observations of targets that have a flux greater than 1.0 x 10^{-10} ergs cm^{-2} s^{-1} $Å^{-1}$ at any wavelength in the 900-1200 Å band.** The bright limit will be reevaluated as the mission progresses, based on on-orbit performance, estimates of the charge remaining in the microchannel plates, and the availability of new observing modes. Changes in the bright limit will be posted at the JHU FUSE Science Center web site <http://fuse.pha.jhu.edu/>. Observations of bright targets will be initially attempted by the PI team due to the inherent risk and the need for close cooperation with the FUSE mission operations team.

Given the uncertainty in predicting fluxes in the FUV, it is possible that targets close to the bright limit may not be scheduled until the second cycle. GI's will be required to demonstrate that their proposed targets do not exceed the bright limit. For sources with poorly determined FUV fluxes, or sources with a flux greater than 1.0 x 10^{-11} ergs cm^{-2} s^{-1} $Å^{-1}$, an initial "snapshot" observation to verify the source flux may be required. Any "snapshot" exposures will be charged against the allocated observing time for that program, and GI's should provide for this time in their proposal. Keep in mind that 2 ksec is charged to the proposal's time allocation for each short exposure. Exposure times and flux determinations for bright objects must comply with the policies outlined in the *FUSE Observer's Guide*.

Emission line objects must adhere to the same bright limit as continuum sources. That is, the peak flux cannot exceed 1.0 x 10^{-10} ergs cm^{-2} s^{-1} $Å^{-1}$. For an unresolved emission line (e.g., a Gaussian line with FWHM ~0.033 Å, which corresponds to a velocity width of ~10 km s^{-1}), this means that the line-integrated flux cannot exceed ~3.3 x 10^{-12} ergs cm^{-2} s^{-1}. The allowable line-integrated flux scales linearly with the linewidth for fully-resolved emission lines.

Based on current estimates of the fixed pattern noise in the detectors, the FUSE Project estimates that signal-to-noise (S/N) ratios of 30:1 will be routinely achievable. Achieving higher S/N spectra with FUSE may be possible, but its feasibility is presently unknown, since the stability of the flat-field calibration will not be determined until the satellite is in orbit. Furthermore, the amount of charge that can be extracted from the microchannel plates is a limited resource requiring careful management by the Project. During Cycle 1, the FUSE Project plans to limit the number of GI and PI team observations requiring S/N > 30:1. GI's desiring observations with S/N ratios greater than 30:1 should provide ample justification for the need for higher S/N and should bear in mind that such performance may not be achievable.

C.3.2 Target Duplication

GI targets are not expected to overlap with those on the PI team reserved target list unless the proposed observation would result in a spectrum with a significantly higher signal-to-noise ratio and/or significantly higher spectral resolution than that indicated by the exposure time listed in Appendix D for the PI target, and then only with compelling scientific justification. Proposers should bear in mind that the FUSE instrument has essentially only one observational mode. Aside from small differences resulting from the choice of aperture, the exposure time alone defines the achievable signal-to-noise ratio for a given spectral resolution for observations of point sources. The target's name and celestial coordinates (RA & DEC in epoch J2000) will be considered when judging any potential target duplications.

C.3.3 Target List Modifications

After selection of Cycle 1 GI programs, additional GI and PI team targets may be added with the approval of the Project Scientist. Any new target must be consistent with the program's scientific objectives and must not already be allocated to another program.

C.3.4 Solar System Targets

Since solar system objects are not defined uniquely by a fixed RA and DEC, a different policy applies with regard to protecting the solar system observations planned by the PI team. A GI may propose to observe a solar system target, even if it has been reserved by the PI team, if the proposed observation and scientific investigation differs significantly from that proposed by the PI team. The criteria used to differentiate the proposed GI observations from those of the PI team are the scientific goals and other factors, including aperture size, aperture location on the target, required resolving power, and integration time. GI proposals for reserved solar system targets should clearly state the differences between the proposed observation and those of the PI team. The PI team solar system observations are those described in the abstracts included in Appendix F (Program ID's P109, P120, and P180).

Proposers should be aware that only a limited number of moving target observations are expected during Cycle 1. Moving targets require special commanding and a significantly larger planning effort than inertially fixed targets. They require a high degree of familiarity on the part of the user with the FUSE satellite capabilities, as well as intensive coordination with the operations team. In addition, initial observations of moving targets may require the development of new software and spacecraft commands. For these reasons, the initial observations of moving targets will be attempted by the PI team. The FUSE Project will attempt to implement a small number of Cycle 1 GI observations of solar system targets, if selected by NASA following the Cycle 1 peer review. However, during Cycle 1, the Project will emphasize implementation of nominal operations in an efficient manner and, as a result, it may be necessary to delay such observations to the second year. The more demands on mission capabilities and resources required by a moving target observation, the less likely it is to be implemented in Cycle 1.

It is uncertain when or even if the spacecraft will be capable of reliable operation at beta angles greater than 105°. (*Beta* is the angle between the antisolar direction and the telescope line of sight.) The feasibility of observations at large beta angles, approaching the absolute limit of 135°, will not be known until well into the mission. Therefore, observations of Venus and comets close to the Sun will be attempted only as PI team projects during Cycles 1 and 2.

C.3.5 Calibration Targets

Appendix E contains the current list of potential FUSE calibration targets. Astronomical targets are needed for photometric, flat-field, and wavelength calibration. Some, but probably not all, of these objects will be observed for calibration purposes. GI's are free to include calibration targets as scientific targets in their programs, provided they are not also on the PI team target list (see the discussion of FUSE data rights in Section C.1.4). The FUSE Project may continue to use these objects for calibration, even if the target is allocated to a GI or PI team program. Several of these calibration targets already appear on the PI team reserved target list.

C.4 Funding for U.S. Investigators

Limited funds for awards under this NRA are expected to be available to investigators at U.S. institutions subject to the annual NASA budget cycle. Budgets should **not** be submitted with FUSE proposals submitted in response to this NRA. Successful proposers at U.S. institutions, including U.S. Co-Investigators on successful non-U.S. proposals, will be eligible for funding and will be asked to submit a budget after selection. An institutional signature will not be required until the time a budget is submitted.

C.5 Obtaining the Phase 1 Proposal Form and Instructions

The Phase 1 LaTeX Proposal Form and style file may be retrieved automatically via email by sending a message to <fuse_prop@fusegi.gsfc.nasa.gov> with the word "help" as the subject of the message. The necessary files will automatically be sent by email. These files, plus the instructions for preparing the Proposal Form, are also available electronically from the FUSE Guest Investigator Program web site <http://fusewww.gsfc.nasa.gov/fuse/>. Printed copies are available from the FUSE Project Scientist at the address given below.

C.6 Notices of Intent to Propose

In order to facilitate planning for the proposal evaluation process and the timely selection of scientific peer review panels, investigators intending to submit proposals for participation in this program should notify NASA by the date given in the letter of solicitation to this NRA. A brief notice of intent, containing the tentative title of the investigation, name and affiliation of the PI and any Co-I's, and a summary of the objectives of the proposed investigation should be sent either electronically **or** in printed format to the FUSE Project Scientist at the addresses given below.

C.7 Proposal Submission

Each proposer must submit a completed Proposal Form and 12 copies of the printed proposal. **Electronic submission of the LaTeX Proposal Form is required of all proposers**.

1. Send the Proposal Form to: fuse_prop@fusegi.gsfc.nasa.gov
   An acknowledgment of receipt will be sent to the proposal submitter by return E-mail.
2. Send 12 printed copies of the proposal to:

   FUSE Guest Investigator Program
   Laboratory for Astronomy and Solar Physics
   Code 681
   Building 21, Room 114
   Goddard Space Flight Center
   National Aeronautics and Space Administration
   Greenbelt, MD 20771
   USA

All proposal material must arrive at the above address by the closing date given in the Cover Letter to this NRA and the first page of this Appendix in order to be included in the Cycle 1 proposal review.

C.8 Evaluation and Selection Process

All proposals submitted in response to this NRA by its deadline will be reviewed for scientific merit and for technical feasibility. Proposals will be evaluated in a competitive peer review conducted by NASA Headquarters. The peer review will be carried out by panels organized according to research area. The panel membership will include scientists from the U.S., Canada, and France. Upon completion of the review by the individual panels, a final cross-discipline panel review will be held, chaired by a NASA HQ representative, to synthesize the results of the individual panels. Based on these results, the FUSE Program Scientist will then develop a recommendation for the total program to be submitted to the Selection Official.

The final proposal selection will be made by the Director, Research Program Management Division, Office of Space Science.

The following criteria, listed in descending order of importance, will be used in evaluating Cycle 1 proposals for the FUSE Guest Investigator Program:

1. The overall scientific merit of the proposed investigation;
2. The suitability of using the FUSE satellite for the proposed investigation, the feasibility of accomplishing the objectives of the investigation, and the feasibility of the data analysis techniques;
3. The competence and relevant experience of the Principal Investigator and any collaborators to carry the investigation to a successful conclusion, including timely publication of the research in peer reviewed journals.

For U.S. proposers, the E/PO evaluation of any proposed Education/Public Outreach activity will be used to discriminate among closely competing proposals.

The FUSE Science Center at JHU will provide the scientific review panels with an assessment of the technical feasibility of each GI proposal. After acceptance of an observing program by NASA, successful proposers must prepare detailed Phase 2 observing plans for submission to JHU. These will again be assessed for feasibility. Should there be any question regarding the safety or feasibility of individual observations, the FUSE PI, in consultation with the FUSE Project Scientist, will make the final decision as to whether or not to attempt or postpone a particular observation, based on the latest information available regarding the satellite's on-orbit performance.

C.9 Other Conditions

NASA may select only a portion of a proposer's investigation, in which case the investigator will be given the opportunity to accept or decline such partial acceptance.

C.10 Schedule

The schedule for the review and selection of proposals for this NRA follows. Note that the dates of events planned beyond the proposal due date are estimates and subject to change.

February 9, 1998	Release of the NRA
April 9, 1998	Notices of Intent due
May 8, 1998	Proposals due
June-July 1998	Peer review of proposals
July 1998	Announcement of selections
October 1998	FUSE launch
January 1999	Beginning of Guest Investigator observations

C.11 Education and Public Outreach (U.S. Proposers Only)

The Office of Space Science (OSS) has developed a comprehensive approach for making education at all levels (with a particular emphasis on pre-college education) and the enhancement of public understanding of space science integral parts of all of its missions and research programs. The two key documents that establish the basic policies and guide all OSS Education and Outreach activities are a strategic plan entitled *Partners in Education: A Strategy for Integrating Education and Public Outreach Into NASA's Space Science Programs* (March 1995), and an accompanying implementation plan entitled *Implementing the Office of Space Science (OSS) Education/Public Outreach Strategy* (1996). Both are available and can be accessed on the World Wide Web by selecting "Education and Outreach" from the menu on the OSS homepage at <http://www.hq.nasa.gov/office/oss>, or from Dr. Jeffrey Rosendhal, Code S, NASA Headquarters, Washington, DC 20546-0001, USA.

In accord with these established OSS policies, proposers to this NRA are strongly encouraged to include an Education/Public Outreach (E/PO) component as part of their scientific research proposal. Note that E/PO activities may be funded only in conjunction with a "parent" research proposal. Up to $10K per year may be proposed for an E/PO program, although larger budgets will be considered based on the demonstrated merits of the proposed E/PO activity. A successful E/PO proposal will be funded out of OSS E/PO funds which are independent of the FUSE Guest Investigator funds.

Every E/PO component of a research proposal will be evaluated by appropriate professional education and outreach personnel (see criteria below), and the results of these reviews will be transmitted to the Program Scientist prior to selection. Results of these E/PO reviews will be used to aid in discriminating between research proposals having otherwise comparable science, technical, and programmatic merits. The OSS Selecting Official will specifically take into account the presence of a proposed E/PO component and its review rating when deciding on final selections and funding levels. As many E/PO proposals of merit as possible will be funded within the current budget of about $1.5M that is available for their support through all Fiscal Year 1998 OSS NRA's. Regardless of whether the "parent" research proposal is selected or not, the review of each E/PO proposal will be conveyed to the proposer as part of their debriefing.

The broad evaluation criteria against which a proposed E/PO activity will be judged are:

- The effectiveness and realism of the proposed E/PO program;
- The establishment of effective, long-duration partnerships with institutions and/or personnel in the fields of educational and/or public outreach as the basis for and an integral element of the proposed E/PO program;
- The prospects for the proposed E/PO program to have a "multiplier effect" reaching audiences well beyond those directly targeted by the proposed activity (e.g., prospects for the broad dissemination of a planned E/PO product);
- Where relevant, the degree to which the proposed E/PO program benefits and promotes nationally recognized and endorsed efforts in education reform and ongoing reform efforts being carried out at the state, district, or local levels;
- The degree to which the proposed E/PO effort contributes to the training of, involvement in, and broad understanding of science and technology by underserved/underutilized groups;
- The prospects for building on, taking advantage of, and leveraging existing and/or ancillary resources beyond those directly requested in the proposal;
- The plans for evaluating the effectiveness and impact of the proposed education/outreach activity;
- The capability, commitment, and experience of the proposer to carry out the proposed E/PO program; and
- The adequacy and realism of the proposed budget (including any additional resources outside those requested from NASA).

Note that originality of the proposed effort is not a criterion; rather NASA OSS seeks assurance that an effective and appropriate E/PO activity has been planned and will be executed. Additional guidance is contained in the OSS E/PO strategy and implementation plans referenced above. General adherence to the principles outlined in the OSS implementation plan will be explicitly considered in arriving at funding decisions.

SPECIAL NOTE: To directly aid space science research personnel in identifying suitable education and/or outreach opportunities and to help develop partnerships between the space science and education/outreach communities, NASA OSS initiated in 1997 an "Education and Outreach Broker/Facilitator Program" (see NRA 97-OSS-07). The goal of this Broker/Facilitator program is to search out and establish high leverage opportunities, arrange alliances between educators and OSS-supported scientists, help scientists turn results from space science missions and programs into educationally appropriate products and/or services, and arrange for the results from such education and outreach activities to be disseminated regionally and/or nationally. Further information about this program, a list of the selected OSS Broker/Facilitators, and information on the services to be provided to the space science community by the Broker/Facilitators may also be accessed through the OSS homepage as described above. Note that the four theme-oriented Education Forums listed on the OSS homepage also serve as Broker/Facilitators and may be consulted for assistance as well. Prospective proposers are strongly encouraged to make use of these resources to help identify suitable E/PO opportunities and arrange appropriate alliances.

The guidelines for the preparation and submission of the E/PO component of a research proposal submitted in response to this NRA are as follows:

- The body of an E/PO proposal should be restricted to five pages or less, and begin with a brief summary of the proposed program followed by a description of its objectives and plan of activity. It should discuss the intended involvement of the Principal Investigator of the "parent" research proposal as well as that of any additional personnel who would be responsible for the E/PO effort and/or the respective institutional responsibilities if a partnership is proposed.
- The E/PO evaluation is a one stage evaluation, and the realism and adequacy of the proposed budget is an evaluation criterion. Therefore, a budget is required with any E/PO proposal which is submitted in conjunction with a FUSE observing proposal even though budgets are not required for a FUSE proposal. NASA is willing to accept an "informal" budget with the E/PO proposal. An "informal" budget should clearly spell out the scope of the resources required and the major components of the budget. Any subsequently submitted FUSE budget proposal must include and be fully consistent with the "informal" E/PO budget. Whether a proposer submits a full or informal E/PO budget with his/her E/PO proposal should be consistent with the rules and regulations of the proposer's home institution.
- E/PO proposals are to be submitted electronically by uploading the proposal (in a wide variety of formats) to a secure Web site at the Lunar and Planetary Institute. The World Wide Web site for submitting an E/PO Proposal is <http://cass.jsc.nasa.gov/panel/>. Proposers without access to the Web, or who experience difficulty in using this site, should contact the Lunar and Planetary Institute by e-mail at panel@lpi.jsc.nasa.gov or by phone at 281-486-2156 or 281-486-2166 for assistance.

Finally, attention is also called to the Initiative to Develop Education through Astronomy and Space Science (IDEAS) program administered by the Space Telescope Science Institute (STScI) on behalf of OSS. This program, which currently selects proposals <u>yearly</u>, provides awards of up to $10K (with a few up to $40K) to enhance and encourage the participation of space scientists in E/PO activities. Annual solicitations for the IDEAS program have typically been released in July with proposals due in October. The IDEAS program is open to any space scientist based in the U.S. regardless of whether or not they hold a research grant from NASA OSS. E-mail inquiries about IDEAS may be directed to <IDEAS@stsci.edu>. The current request for proposals is posted on the World Wide Web at <http://oposite.stsci.edu/pubinfo/edugroup/ideas.html>. Inquiries by surface mail may be addressed to

IDEAS Program, OPO
Space Telescope Science Institute
3700 San Martin Drive
Baltimore, MD 21218.

C.12 For Further Information

Policy questions regarding this NRA and the FUSE GI Program should be addressed to:

Dr. Hashima Hasan
FUSE Program Scientist
Office of Space Science
Code SR
National Aeronautics and Space Administration
Washington, DC 20546-0001
USA

TEL: 202-358-0377, FAX: 202-358-3096
E-mail: hashima.hasan@hq.nasa.gov

Scientific and technical questions about the FUSE Guest Investigator Program and requests for printed copies of documentation mentioned in this NRA should be addressed to:

Dr. George Sonneborn
FUSE Project Scientist
Laboratory for Astronomy and Solar Physics
Code 681
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771
USA

TEL: 301-286-3665 FAX: 301-286-1753
E-mail: sonneborn@stars.gsfc.nasa.gov

Questions regarding the technical performance of the FUSE mission should be addressed to:

Dr. Harold Weaver
Deptartment of Physics and Astronomy
Johns Hopkins University
Baltimore, MD 21218
USA

TEL: 410-516-4251,   FAX: 410-516-5494
E-mail: fuse_support@pha.jhu.edu

Electronic versions of all appendices are available by anonymous ftp or the World Wide Web <http://fusewww.gsfc.nasa.gov/fuse/>

FUSE PI Team Two-Year Reserved Target List

This Appendix contains targets reserved for the FUSE PI Team scientific programs. These targets are protected for two years for use in conducting the PI team science program, with the qualifications described in Appendix C.3.2. The listing is sorted in order of increasing Right Ascension (J2000.0). Calibration targets are listed separately in Appendix E.

The information listed below includes the Program Identification, the target name, J2000 equatorial coordinates, total planned exposure time, V magnitude (when appropriate), and an indicator of the spectral type or general object type. The Program ID permits cross-referencing of a target with its primary science program, as described by the abstract listings in Appendix F.

Prog ID	Target Name	RA (J2000.0)	DEC (J2000.0)	Exposure Time (s)	V	Object Type
P122	HD224868	00 01 21.60	+60 50 22.0	3600	7.27	B0Ib
P101	HD73	00 05 36.80	+43 24 5.0	300	8.48	B1.5IV
P101	MRK335	00 06 19.30	+20 12 9.0	23700	13.90	Syft1
P104	WD0005+511	00 08 17.00	+51 22 54.0	5000	13.32	WD
P119	HD560	00 10 2.00	+11 08 44.0	2000	5.50	B9Vn
P184	M31OB78-231	00 40 29.70	+40 44 30.0	4000	18.30	O8
P101	HD3827	00 41 12.10	+39 36 14.0	300	8.01	B0.7V
P104	WD0038+199	00 41 35.00	+20 09 12.0	17000	14.56	WD
P117	HD4004	00 43 28.30	+64 45 44.0	4000	10.54	WN5
P118	HD4128	00 43 34.50	-17 59 13.8	11560	2.04	K0III
P117	AV14	00 46 32.66	-73 06 5.6	2000	13.77	O3-4V
P115	AV15	00 46 42.19	-73 24 54.7	15000	13.20	O7II
P104	BD-12D134	00 47 3.30	-11 52 19.0	800	11.96	CSPN
P117	AV26	00 47 50.07	-73 08 20.7	2000	12.55	O7III
P115	AV47	00 48 51.35	-73 25 57.6	15000	13.38	O8III
P101	JL212	00 49 1.30	-56 05 49.0	2600	10.34	B2
P115	AV69	00 50 17.40	-72 53 29.9	15000	13.39	O7III
P115	AV75	00 50 32.50	-72 52 36.2	15000	12.78	O5III
P117	AV83	00 50 52.01	-72 42 14.5	2000	13.38	O7.5I
P115	AV95	00 51 21.54	-72 44 12.9	15000	13.91	O7.5III
P102	HD5005A	00 52 49.40	+56 37 40.0	3000	7.76	O6.5Vf
P111	IZW1	00 53 34.90	+12 41 36.0	15000	14.40	AGN
P107	PG0052+251	00 54 52.20	+25 25 39.0	2000	15.42	QSO
P101	TONS180	00 57 20.00	-22 22 56.0	27000	14.34	Syft1
P117	AV207	00 58 33.19	-71 55 46.5	2000	14.37	O7V
P117	NGC346-6	00 58 57.74	-72 10 33.6	2000	14.02	O4V((f))
P117	NGC346-4	00 59 0.39	-72 10 37.9	2000	13.66	O5-6V
P117	NGC346-3	00 59 1.09	-72 10 28.2	2000	13.50	O3III(f)
P117	NGC346-1	00 59 4.81	-72 10 24.8	2000	12.57	O4III(f)
P103	SK78	00 59 26.70	-72 09 55.0	4200	11.69	OB+WN3

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P103	SK80	00 59 30.00	-72 11 0.0	9500	12.36	O7Iaf+
P117	AV232	00 59 32.19	-72 10 46.2	2000	12.36	O7Iaf+
P103	SK82	00 59 42.00	-72 45 0.0	12700	12.16	B0Iaw
P107	MRK352	00 59 53.30	+31 49 37.0	2000	14.80	Syft1
P117	AV238	00 59 55.61	-72 13 37.7	2000	13.77	O9III
P117	AV243	01 00 6.80	-72 47 19.0	2000	13.87	O6V
P117	AV242	01 00 6.84	-72 13 57.0	2000	12.11	B1Ia
P117	AV264	01 01 7.72	-71 59 58.6	2000	12.36	B2Ia
P115	AV321	01 02 57.04	-72 08 9.3	15000	13.38	O9I
P103	SK108	01 03 8.70	-72 06 11.0	8000	12.37	O6.5n+WN3
P117	AV327	01 03 10.58	-72 02 13.8	2000	13.25	O9II
P117	AV372	01 04 55.73	-72 46 47.7	2000	12.63	O9I
P115	AV378	01 05 9.44	-72 05 35.0	15000	13.88	O9III
P117	AV388	01 05 39.62	-72 29 26.8	2000	14.12	O4V
P117	AV423	01 07 40.43	-72 50 59.6	2000	13.28	O9.5I
Q107	SK143	01 10 55.60	-72 42 54.7	18000	12.88	O9.7Ib
P104	WD0109-264	01 12 11.50	-26 13 28.0	39000	13.15	WD
P117	AV469	01 12 28.96	-72 29 28.8	2000	13.20	O8II
P103	SK159	01 15 48.00	-73 21 0.0	10600	11.89	B0.5Iaw
P117	AV488	01 15 58.84	-73 21 24.1	10000	11.90	B0.5Iaw
P107	TONS210	01 21 51.50	-28 20 57.0	2000	14.70	QSO
P191	MRK357	01 22 40.20	+23 10 10.0	24000	16.00	GAL
P101	FAIRALL9	01 23 45.70	-58 48 22.0	28000	13.23	Syft1
P103	SK188	01 31 6.00	-73 26 0.0	12700	12.88	WO4+O7III
P184	M33FUV444	01 34 9.90	+30 39 11.0	2000	17.70	O6
P184	M33OB88-7	01 34 59.40	+30 42 1.0	4000	18.50	O8
P122	HDE232522	01 46 2.10	+55 19 55.0	830	8.67	B1II
P107	MRK1014	01 59 50.20	+00 23 41.0	2000	15.69	Syft1
P102	HD12323	02 02 30.00	+55 37 27.0	1500	8.90	ON9V
P186	HD12230	02 05 5.30	+77 16 55.5	2000	5.27	F0Vn
P101	HD12740	02 06 11.40	+49 09 23.0	500	7.94	B1.5II
P184	TT-ARI	02 06 53.10	+15 17 43.0	2000	10.00	CV
P107	MRK586	02 07 49.80	+02 42 56.0	2000	15.39	QSO
P102	HD13268	02 11 29.60	+56 09 32.0	8400	8.18	ON8V
P107	MRK590	02 14 33.60	-00 46 0.0	2000	13.85	Syft1.2
P102	HD13745	02 15 45.80	+55 59 47.0	7300	7.83	O9.7IIn
P102	HD14434	02 21 52.30	+56 54 18.0	14300	8.49	O5.5Vnfp
P101	HD14633	02 22 54.20	+41 28 49.0	300	7.46	O8.5V
P105	BD+48D658	02 23 23.50	+49 01 56.0	4800	8.78	B1
P102	HD15137	02 27 59.80	+52 32 58.0	1700	7.88	O9.5II-IIIn
P117	HD15558	02 32 42.30	+61 27 22.0	300	7.86	O5IIIf
P102	HD15642	02 32 56.30	+55 19 39.0	4600	8.54	O9.5IIIn
P101	NGC985	02 34 37.30	-08 47 8.0	46600	14.50	Syft
P104	WD0232+035	02 35 6.00	+03 44 0.0	8000	12.25	WD(DA+dM?)
P111	NGC1068	02 42 40.69	-00 00 50.5	18000	11.40	AGN
P104	HD17573	02 49 58.70	+27 15 44.0	2000	3.63	B8Vn
P101	HD18100	02 53 40.70	-26 09 20.0	300	8.46	B1V
P133	K1-26	02 56 58.30	-44 10 19.0	2600	15.40	sdO
P107	MRK609	03 25 25.40	-06 08 38.0	2000	14.50	Syft1.8
P116	HD21483	03 28 46.53	+30 22 31.9	6000	7.06	B3III
P104	HD22049	03 32 59.10	-09 27 31.0	41000	3.73	K2V
P115	NGC1360	03 33 14.74	-25 52 9.5	4500	11.30	sd(O)

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P101	HD22586	03 35 37.90	-52 33 24.0	700	8.03	B2III
P153	HR-1099	03 36 47.00	+00 35 24.0	16000	5.70	K1IV
P193	HD23180	03 44 19.04	+32 17 18.3	2000	3.82	B1III
P116	BD+31D643	03 44 34.08	+32 09 46.8	23900	8.51	B5V
P186	HD23628	03 47 23.90	+24 35 22.5	4530	7.66	A4V
P104	HD23850	03 49 9.60	+24 03 15.0	2000	3.63	B8III
P154	V471-TAU	03 50 24.00	+17 14 48.0	36000	9.20	K0
P193	HD24534	03 55 22.99	+31 02 45.0	6000	6.10	O9Vpe
P115	NGC1535	04 14 15.72	-12 44 22.0	4500	12.20	sd(O)
P163	T-TAU	04 21 59.40	+19 32 6.5	20000	10.40	TTAU
P119	HD27638	04 22 34.80	+25 37 46.0	4000	5.40	B9V
P116	HD27778	04 23 59.69	+24 18 4.2	5900	6.36	B3V
P107	3C120	04 33 11.10	+05 21 16.0	2000	14.20	Syft1
P104	HD29139	04 35 55.00	+16 30 43.0	19000	0.85	K5III
P107	MRK618	04 36 22.20	-10 22 34.0	2000	14.50	Syft1
P122	HD29376	04 37 54.30	+07 19 3.0	440	7.02	B3Vsb
P104	WD0439+466	04 43 20.90	+46 42 5.0	7000	12.67	WD
P102	HD30677	04 50 3.60	+08 24 28.0	380	6.84	B1II-IIIn
P103	SK-67D05	04 50 24.00	-67 40 0.0	11000	11.34	O6Iaf+
P117	SK-67D14	04 54 31.92	-67 15 24.9	2000	11.52	B1Ia
P103	SK-67D18	04 55 12.00	-67 11 0.0	10400	12.02	O6-7+WN5-6
P117	HD32109	04 55 31.50	-67 30 1.0	2000	13.87	WN4
P119	HD31293	04 55 45.80	+30 33 5.0	18000	7.10	A0pe
P104	WD0455-281	04 57 12.70	-28 08 10.0	31000	13.95	WD
P117	HD32402	04 57 24.19	-68 23 57.2	2000	13.30	WC4
P117	SK-69D52	04 57 48.50	-69 52 22.0	2000	11.50	B2Ia
P103	SK-65D21	05 01 24.00	-65 42 0.0	20900	12.02	O9.5Ia
P103	SK-65D22	05 01 24.00	-65 52 0.0	5200	12.07	O6Iaf+
P135	HD31964	05 01 58.10	+43 49 24.0	30000	3.00	A9Ia
P164	ZETA-AUR	05 02 28.70	+41 04 33.0	2000	3.75	ZAUR
P117	HD33133	05 03 10.20	-66 40 54.0	2000	12.69	WN8
P103	SK-69D59	05 03 12.00	-69 02 0.0	5200	12.13	B0Ia
P117	SK-70D60	05 04 40.94	-70 15 34.5	2000	13.85	O4V
P117	SK-70D69	05 05 18.73	-70 25 49.8	2000	13.90	O4V
P117	SK-68D41	05 05 27.20	-68 10 2.7	2000	12.01	B0.5Ia
P104	G191-B2B	05 05 30.30	+52 49 54.0	5000	11.80	WD
P117	SK-68D52	05 07 16.00	-68 32 5.0	2000	11.70	B0Ia
P184	0513-69	05 13 39.30	-69 32 1.0	2000	16.50	CV
P117	SK-67D69	05 14 20.16	-67 08 3.5	2000	13.09	O3III
P101	AKN120	05 16 11.50	-00 09 1.0	30800	14.60	Syft1
P104	HD34029	05 16 40.90	+46 00 14.0	22000	0.08	G5III+G0III
P122	HD34333	05 18 21.00	+36 37 55.0	870	7.71	B3+B3V
P117	SK-69D104	05 18 59.57	-69 12 54.7	2000	12.10	O6Ib(f)
P103	SK-67D76	05 20 0.00	-67 20 0.0	7400	12.42	B0Ia
P117	SK-65D44	05 20 18.00	-65 24 13.0	2000	13.65	O9V
P101	HD34656	05 20 43.00	+37 26 19.0	300	6.75	O7IIf
P122	HD35215	05 24 28.30	+30 11 32.0	7500	9.41	B1V
P117	SK-69D124	05 25 18.37	-69 03 11.1	2000	12.66	O9Ib
P117	SK-67D101	05 25 56.36	-67 30 28.7	2000	12.63	O9III
P103	SK-67D104	05 26 4.00	-67 29 48.0	9500	11.44	OB+WC5
P103	SK-68D80	05 26 33.00	-68 50 12.0	6900	12.40	WC5+OB
P117	BI170	05 26 47.79	-69 06 11.7	2000	13.09	O9.5II

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P117	SK-67D111	05 26 48.00	-67 29 33.0	2000	12.57	O7Ib(f)
P117	BI173	05 27 10.08	-69 07 56.2	2000	13.00	O8III
P115	IC418	05 27 28.81	-12 41 48.3	4500	0.00	CSPN
P117	SK-70D91	05 27 33.74	-70 36 48.3	2000	12.78	O6.5V
P117	SK-66D100	05 27 45.59	-66 55 15.0	2000	13.26	O6II(f)
P117	HDE269582	05 27 52.75	-68 59 8.6	2000	11.88	WN10
P179	HD36705	05 28 44.50	-65 27 2.0	5030	6.83	K1III
P117	HD37026	05 30 12.22	-67 26 8.4	2000	14.30	WC4
P103	SK-71D45	05 31 18.00	-71 04 0.0	11600	11.47	O4If
P117	HDE269687	05 31 25.61	-69 05 38.4	2000	11.90	WN11
P103	SK-67D166	05 31 42.00	-67 38 6.0	12900	12.27	O4If+
P103	SK-67D169	05 31 48.00	-67 03 0.0	33900	12.18	B1Ia
P117	SK-67D167	05 31 51.98	-67 39 41.1	2000	12.54	O4Inf+
P119	HD36408	05 32 14.10	+17 03 30.0	2000	5.50	B7IIIe
P166	LMC-X-4	05 32 49.30	-66 22 14.0	10000	13.80	O7IV
P117	SK-67D191	05 33 34.12	-67 30 19.6	2000	13.46	O8V
P117	BI208	05 33 57.45	-67 24 20.0	4000	14.02	O7V
P117	HD37680	05 34 19.39	-69 45 10.0	2000	13.35	WC4
P101	HD36841	05 34 33.60	-00 23 12.0	5700	8.60	O8
P117	HD269810	05 35 13.92	-67 33 27.0	2000	12.26	O3III(f)
P116	HD37021	05 35 16.00	-05 23 4.0	2000	7.96	B0V
P113	SN1987A	05 35 28.13	-69 16 11.0	50000	19.60	SNR
P113	SN1987A-STAR3	05 35 28.40	-69 11 11.7	23000	15.80	B1V
P152	HD37062	05 35 31.00	-05 25 16.0	4000	8.20	B1Ve
P116	HD37061	05 35 31.30	-05 17 54.9	2000	6.82	B1V
P117	BI229	05 35 32.20	-66 02 37.6	2000	12.95	O7III
P117	SK-66D169	05 36 54.50	-66 38 25.0	2000	11.56	O9.7Ia+
P117	SK-66D172	05 37 5.56	-66 21 35.7	2000	13.13	O5V
P117	SK-68D135	05 37 48.60	-68 55 8.0	2000	11.36	ON9.7Ia+
P117	MK42	05 38 42.10	-69 05 54.7	2000	10.96	O3If/WN
P103	SK-69D243	05 38 42.80	-69 06 3.0	5800	9.50	O3+OB+WN5
P103	SK-69D246	05 38 54.00	-69 01 0.0	10400	11.13	WN7
P117	HDE269927	05 38 58.25	-69 29 19.1	2000	12.48	WN9
P117	SK-69D257	05 39 58.96	-69 44 4.3	4000	12.38	O9II
P116	HD37903	05 41 38.32	-02 15 32.6	2000	7.83	B1.5V
P116	HD38087	05 43 0.48	-02 18 45.4	2100	8.28	B5V
P117	BI272	05 44 23.18	-67 14 29.3	2000	13.20	O7II
Q119	HD39060	05 47 17.00	-51 04 3.0	20000	3.80	A5V
P117	SK-70D115	05 48 49.76	-70 03 57.5	2000	12.24	O6.5III
P102	HD39680	05 54 44.70	+13 51 17.0	1500	7.85	O6.5Vnepv
P118	HD39801	05 55 10.20	+07 24 25.2	10000	0.80	M2Ia
P104	HD39659	05 56 24.00	+46 06 17.0	5200	11.59	CSPN
P122	HD40005	05 56 50.60	+16 21 19.0	300	7.24	B3Vsb
P101	PKS0558-504	05 59 47.40	-50 26 52.0	54800	15.00	QSO
P116	WALKER67	06 04 37.20	-09 47 30.0	14100	10.79	B1.5V
P102	HD41161	06 05 52.50	+48 14 58.0	300	6.71	O8.5Vn
P102	HD42088	06 09 39.50	+20 29 16.0	1400	7.55	O6.5V
P102	HD42401	06 10 59.10	+11 59 41.0	780	7.35	B2V
P104	WD0621-376	06 23 12.10	-37 41 29.0	8000	12.09	WD
P118	HD45348	06 23 57.00	-52 41 45.6	11720	-0.72	F0II
P102	HD45314	06 27 15.80	+14 53 22.0	1200	6.64	O9Vpe
P152	HD45677	06 28 17.00	-13 03 10.0	8000	7.60	B2IVe

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P107	HS0624+6907	06 30 2.50	+69 05 4.0	2000	14.20	QSO
P116	HD46056	06 31 20.88	+04 50 4.0	2000	8.16	B1V
P102	HD46150	06 31 55.50	+04 56 35.0	1400	6.75	O5Vf
P116	HD46202	06 32 10.48	+04 58 0.1	2000	8.19	O9V
P151	HD47088	06 37 10.40	+06 03 33.2	2000	7.60	B1III
P151	HD47129	06 37 24.00	+06 08 7.1	1000	6.10	O8III
P151	HD47240	06 37 52.70	+04 57 25.1	2000	6.20	B1II
P102	HD47360	06 38 23.00	+04 37 27.0	8700	8.19	B0.5V
P151	HD47382	06 38 28.60	+04 36 26.1	5000	7.10	B0III
P102	HD47417	06 38 47.90	+06 54 7.0	1000	6.97	B0IV
P131	HD47732	06 40 28.60	+09 49 4.4	900	8.10	B3V
P131	HD47777	06 40 42.30	+09 39 21.4	975	7.90	B2V
P131	HDE261878	06 40 51.50	+09 51 49.8	2670	9.00	B3V
P131	HD47839	06 40 58.70	+09 53 44.5	300	4.70	O7V
P131	HD47961	06 41 27.40	+09 51 13.5	765	7.50	B3V
P102	HD48279	06 42 40.50	+01 42 58.0	4300	7.97	O8V
P104	HD48915	06 45 10.80	-16 41 58.0	20000	-1.46	A1V
P104	WD0642-166	06 45 11.00	-16 42 6.0	23000	8.30	WD
P119	HD50138	06 51 33.30	-06 58 0.0	8000	6.70	B6-B9e
P187	PSR0656+14	06 59 48.11	+14 14 21.5	12000	24.00	PSR
P102	HD52463	07 00 12.20	-27 47 60.0	460	8.30	B3V
P122	HD52266	07 00 21.10	-05 49 37.0	500	7.23	O9V
P116	HD53367	07 04 25.46	-10 27 16.7	22000	6.94	B0IVe
P101	VIIZW118	07 07 13.00	+64 35 59.0	61200	14.60	Syft1
P152	HD56014	07 14 15.00	-26 21 9.0	1000	4.70	B3IIIe
P122	LS277	07 16 12.20	-08 31 14.0	13900	9.78	NA
P122	CD-20D2366	07 25 1.90	-21 09 33.0	4700	8.27	B0.5III
P102	HD58510	07 25 7.90	-21 10 27.0	1000	6.79	B1Ib-II
P133	NGC2371	07 25 35.30	+29 29 36.0	2000	14.80	WC8-OVI
P122	HD60196	07 32 11.90	-28 44 4.0	2900	9.01	B1III
P105	HD60369	07 33 1.80	-28 19 33.0	7300	8.15	O9IV
P107	MRK9	07 36 57.10	+58 46 14.0	2000	15.29	Syft1
P102	HD61347	07 38 16.10	-13 51 2.0	13000	8.43	O9Ib
P104	HD61421	07 39 20.40	+05 14 21.0	10000	0.38	F5IV-V
P101	MRK79	07 42 32.30	+49 48 41.0	89000	13.30	Syft1
P116	HD62542	07 42 37.12	-42 13 46.7	10000	8.03	B3V
P179	HD62044	07 43 18.70	+28 53 0.0	8550	4.28	K1III
P122	HD62866	07 45 12.90	-20 48 37.0	9400	9.01	B0.5IIIn
P118	HD62509	07 45 21.30	+28 01 36.6	20600	1.15	K0IIIp
P102	HD63005	07 45 49.00	-26 29 31.0	1900	9.13	O6Vf
P122	HD64568	07 53 38.20	-26 14 2.0	7500	9.38	O4Vf
P154	U-GEM	07 55 5.00	+22 00 5.0	12000	14.90	CV
P102	HD65079	07 57 3.90	+02 57 3.0	370	7.83	B2Vne
P107	IR07546+3928	07 58 0.00	+39 20 29.0	2000	14.36	Syft1
P122	HD66695	08 03 42.70	-27 02 47.0	6000	9.78	B0.5IV
P101	HD66788	08 04 8.20	-27 29 0.0	1600	9.45	O9V
P152	HD67888	08 08 38.00	-37 40 54.0	4000	6.40	B4Ve
P101	PG0804+761	08 10 58.50	+76 02 43.0	37600	15.20	QSO
P102	HD69106	08 14 3.80	-36 57 9.0	300	7.14	B0.5IVnn
Q112	IX-VEL	08 15 19.10	-49 13 21.0	6000	9.60	CV
P116	HD73882	08 39 9.43	-40 25 9.7	10000	7.21	O9III
P102	HD74194	08 40 47.70	-45 03 31.0	9200	7.57	O8.5Ib

Prog ID	Target Name	RA (2000.0)	DEC	Exposure Time (s)	V	Object Type
P114	VELA-XBRT	08 41 2.43	-44 44 1.8	10000	0.00	NEB
P114	PG0839+399	08 43 12.70	+39 44 49.5	2000	14.60	sdOB
P102	HD74711	08 43 47.50	-46 47 56.0	1400	7.11	B1III
P102	HD74920	08 45 10.50	-46 02 19.0	800	7.53	O8V
P102	HD75309	08 47 27.90	-46 27 5.0	930	7.86	B1IIp
P101	TON951	08 47 42.40	+34 45 4.0	69500	14.00	Syft1
P122	HD77464	09 00 38.00	-51 33 20.0	300	6.70	B2.5V+B2.5V
P166	VELA-X-1	09 02 6.79	-40 33 17.4	10000	6.80	B0Ia
P107	IR09149-6206	09 14 59.10	-62 06 54.0	2000	13.55	Syft1
P101	HDE233622	09 21 33.50	+50 05 57.0	1900	9.97	B1.5
P107	MRK110	09 25 12.90	+52 17 10.0	2000	16.00	Syft1
P198	IZW18	09 34 1.90	+55 14 26.1	18000	15.60	GAL
P104	WD0939+262	09 42 54.00	+26 00 0.0	37000	14.60	WD
P111	PG0946+301	09 49 40.99	+29 55 18.1	25000	16.20	QSO
P101	PG0953+414	09 56 52.40	+41 15 41.0	41600	15.00	QSO
P107	3C232	09 58 20.90	+32 24 2.0	2000	15.78	QSO
P133	NGC3132	10 07 1.80	-40 26 10.0	5200	0.00	AV+sdO
P101	HD88115	10 07 31.80	-62 39 12.0	1100	8.30	B1.5IIn
P107	TON1187	10 13 3.10	+35 51 22.0	2000	15.00	QSO
P102	HD89137	10 15 40.00	-51 15 25.0	640	7.98	ON9.7IIInp
P102	HD90087	10 22 20.80	-59 45 20.0	870	7.80	O9.5III
Q108	NGC3242	10 24 46.00	-18 38 38.9	1000	12.30	CSPN
Q114	HD90972	10 29 35.40	-30 36 25.0	3400	5.60	B9.5V
P101	HE1029-140	10 31 54.30	-14 16 51.0	27000	13.90	QSO
P102	HD91597	10 33 1.10	-60 50 41.0	10000	9.84	O9.5V
P102	HD91651	10 33 30.30	-60 07 35.0	2200	8.86	O9Vn
P104	WD1034+001	10 37 4.00	-00 08 20.0	6000	13.19	WD
P102	HD92554	10 39 48.00	-60 55 0.0	12100	9.47	O9.5IIn
P101	HD92702	10 41 0.20	-57 36 3.0	5100	8.14	B1Iab
P117	HD92809	10 41 38.40	-58 46 19.0	2000	9.08	WC6
P117	HD93129A	10 43 57.40	-59 32 51.0	2000	8.84	O3If
P102	HD93146	10 43 59.90	-60 05 11.0	1600	8.45	O6.5Vf
P102	HD93206	10 44 23.00	-59 59 36.0	550	6.24	O9.7Ib
P102	HD93204	10 44 32.40	-59 44 30.0	3400	8.42	O5Vf
P102	HD93205	10 44 33.80	-59 44 15.0	1000	7.75	O3V
P102	HD93222	10 44 36.30	-60 05 28.0	1600	8.10	O7IIIf
P122	CPD-59D2600	10 44 41.50	-59 46 55.0	12400	8.61	O6V
P102	HD93250	10 44 45.10	-59 33 54.0	4200	7.38	O3Vf
P122	CPD-59D2603	10 44 48.00	-59 44 0.0	8600	8.77	O7V
P122	HDE303308	10 45 6.00	-59 40 5.0	7800	8.17	O3Vf
P101	HD93521	10 48 23.40	+37 34 13.0	300	7.06	O9Vp
P102	HD93827	10 48 31.40	-60 56 10.0	4500	9.31	B1Ibn
P102	HD93843	10 48 37.80	-60 13 25.0	440	7.34	O6IIIf
P101	HD93840	10 49 8.70	-46 46 42.0	700	7.77	B1Ib
P101	BD+38D2182	10 49 12.00	+37 59 0.0	4400	11.25	B3
Q101	HD94414	10 50 56.30	-77 07 27.0	48000	8.00	B2V
P102	HD94493	10 53 15.20	-60 48 53.0	450	7.23	B1Ib
P186	TW-HYA	11 01 58.00	-34 43 36.0	3710	10.9	K7V
P107	PG1100+772	11 04 13.90	+76 58 58.0	2000	15.72	QSO
P101	MRK421	11 04 27.30	+38 12 32.0	19000	12.24	Blazar
Q101	HD96675	11 05 58.20	-76 07 49.0	10000	7.65	B7V
P110	HS1103+6416	11 06 10.85	+64 00 9.4	30000	15.80	QSO

Prog ID	Target Name	RA (2000.0)	DEC	Exposure Time (s)	V	Object Type
P117	HD96548	11 06 17.20	-65 30 35.0	1000	7.70	WN8
P111	NGC3516	11 06 47.55	+72 34 6.9	14000	13.20	AGN
P102	HD96670	11 07 13.80	-59 52 23.0	7200	7.43	O8Ibf
P102	HD96715	11 07 32.90	-59 57 49.0	3500	8.26	O4Vf
P102	HD96917	11 08 42.40	-57 03 57.0	1500	7.08	O8.5Ibf
P122	HD97913	11 14 54.60	-59 10 29.0	3700	8.80	B0.5IVn
P101	HD97991	11 16 11.60	-03 28 20.0	300	7.41	B1V
P101	PG1116+215	11 19 8.70	+21 19 18.0	28600	14.80	QSO
P107	MRK734	11 21 47.10	+11 44 18.0	2000	15.07	Syft1
P110	HE1122-1649	11 24 42.82	-17 05 17.8	48000	16.50	QSO
P102	HD99857	11 28 27.00	-66 29 21.0	1600	7.45	B0.5Ib
P102	HD99890	11 29 5.80	-56 38 39.0	1100	8.28	B0III
P107	MRK1298	11 29 16.60	-04 24 8.0	2000	15.00	Syft1
P122	HD100199	11 31 6.90	-62 56 48.0	480	10.15	B0.5IIIne
P102	HD100213	11 31 10.60	-65 44 32.0	2000	8.22	O8.5Vn
P102	HD100276	11 31 48.10	-60 36 22.0	620	7.16	B0.5Ib
P192	PDS-55	11 31 55.00	-34 36 26.0	16000	11.60	dM2e
P101	HD100340	11 32 49.80	+05 16 36.0	700	10.12	B1V
P119	HD100546	11 33 25.60	-70 11 42.0	8000	6.80	B9Vne
P102	HD101131	11 37 48.40	-63 19 23.0	520	7.15	O6Vf
P122	HDE308813	11 37 58.50	-63 18 59.0	3300	9.28	B1III
P102	HD101190	11 38 10.00	-63 11 49.0	830	7.27	O6Vf
P102	HD101205	11 38 20.40	-63 22 22.0	440	6.42	O7IIInf
P101	NGC3783	11 39 2.00	-37 44 18.0	27600	12.24	Syft1
P102	HD101298	11 39 3.30	-63 25 46.0	2000	8.05	O6Vf
P102	HD101413	11 39 45.90	-63 28 39.0	2900	8.35	O8V
P102	HD101436	11 39 49.90	-63 28 43.0	1400	7.56	O6.5V
Q101	HD102065	11 43 37.80	-80 28 60.0	6000	6.57	B9IV
P107	1143-1810	11 45 40.50	-18 27 16.0	2000	14.58	Syft1
P132	PG1144+005	11 46 35.60	+00 12 29.8	4000	16.20	DOZ1
P102	HD102552	11 47 56.90	-60 33 54.0	3700	8.69	B1IIIn
P102	HD103779	11 56 57.60	-63 14 57.0	400	7.20	B0.5Iab
P101	CPD-72D1184	11 59 0.10	-73 25 46.0	4400	10.68	B0III
P163	HD104237	12 00 5.10	-78 11 34.6	18000	7.00	TTAU
Q109	PG1159-035	12 01 46.00	-03 45 36.0	5000	14.90	PG1159
P102	HD104705	12 03 23.90	-62 41 45.0	720	7.76	B0Ib
P104	WD1202+608	12 04 37.00	+60 31 42.0	32000	13.57	WD(DAO+DA)
P107	PG1202+281	12 04 42.20	+27 54 11.0	2000	15.51	QSO
P117	HD104994	12 05 18.70	-62 03 8.0	2000	10.93	WN3pec
P111	NGC4151	12 10 32.51	+39 24 20.8	10000	12.50	AGN
P107	PG1211+143	12 14 17.60	+14 03 12.0	2000	14.63	Syft1
P107	PG1216+069	12 19 20.90	+06 38 38.0	2000	15.68	QSO
P108	MRK205	12 21 44.10	+75 18 38.0	200000	14.50	QSO
P111	NGC4388	12 25 50.06	+12 39 23.7	10000	13.60	AGN
P107	MRK209	12 26 16.00	+48 29 37.0	2000	15.15	Gal
P101	3C273	12 29 6.70	+02 03 9.0	39000	12.86	QSO
P119	HD108767	12 29 52.50	-16 30 48.0	1000	3.00	B9.5V
P107	PG1229+204	12 32 3.60	+20 09 29.0	2000	15.26	Syft1
Q101	HD108927	12 32 20.00	-78 11 38.0	4000	7.73	B5V
P104	HD109540	12 33 6.70	+82 33 50.0	7000	13.45	CSPN
P101	HD109399	12 35 16.50	-72 42 59.0	900	7.61	B0.7II

Prog ID	Target Name	RA (2000.0)	DEC	Exposure Time (s)	V	Object Type
P134	NGC4631-A	12 42 8.80	+32 34 36.0	30000	0.00	GAL
P134	NGC4631-B	12 42 8.80	+32 33 36.0	20000	0.00	GAL
P134	NGC4631-C	12 42 8.80	+32 32 36.0	10000	0.00	GAL
P116	HD110432	12 42 50.32	-63 03 31.2	2000	5.24	B2Vpe
Q105	T1247-232	12 50 18.80	-23 33 57.0	22000	16.00	GAL
P118	HD111812	12 51 41.90	+27 32 26.9	3125	4.94	G0IIIp
P133	A35	12 53 41.40	-22 51 42.0	2000	0.00	G8IV+sdO
P101	CPD-69D1743	13 00 33.70	-70 12 35.0	700	9.38	B0.5IIIn
P108	PG1259+593	13 01 12.90	+59 02 6.0	200000	15.60	QSO
P108	PKS1302-102	13 05 33.00	-10 33 19.0	200000	14.92	QSO
P107	PG1307+085	13 09 47.00	+08 19 49.0	2000	15.28	QSO
P110	HS1307+4617	13 10 11.69	+46 01 24.5	20000	16.80	QSO
P102	HD114441	13 11 29.50	-55 21 24.0	4300	8.02	B2IVpne
P102	HD115071	13 16 4.80	-62 35 1.0	10500	7.94	B0.5Vn
P104	HZ43	13 16 22.10	+29 05 56.0	21000	12.86	WD
P117	HD115473	13 18 27.70	-58 08 15.0	2000	9.98	WC5
P102	HD116538	13 25 11.90	-51 50 29.0	570	7.92	B2IVn
P102	HD116781	13 27 25.10	-62 38 56.0	2400	7.60	B0IIIne
P101	HD116852	13 30 23.20	-78 51 18.0	900	8.47	O9III
P101	HD118246	13 35 43.30	-06 09 22.0	500	8.07	B4V
P122	HD118571	13 39 15.70	-60 59 1.0	1700	8.76	B0.5IVn
P101	HD119069	13 41 55.70	-45 51 6.0	300	8.43	B1III
P101	VZ1128	13 42 16.8	+28 26 00.7	19400	14.9	PAGB
P122	HD118969	13 42 12.30	-63 42 50.0	7400	9.89	B1V
P101	HD119608	13 44 31.20	-17 56 13.0	700	7.51	B1Ib
P101	HD120086	13 47 19.10	-02 26 37.0	300	7.73	B2V
P112	ABELL1795	13 48 52.51	+26 35 35.1	40000	0.00	CLUS
P108	MRK279	13 53 3.40	+69 18 29.0	200000	14.57	Syft1
P107	PG1351+640	13 53 15.80	+63 45 45.0	2000	14.84	QSO
Q114	HD120991	13 53 56.80	-47 07 41.0	6600	6.10	B2IIIe
P101	HD121800	13 55 15.40	+66 07 0.0	1800	9.11	B1.5V
P111	MRK463	13 56 2.85	+18 22 18.9	10000	15.00	AGN
P101	HD121968	13 58 51.10	-02 54 53.0	1700	10.31	B1V
P107	PG1402+261	14 05 16.20	+25 55 34.0	2000	15.57	Syft1
P107	PG1411+442	14 13 48.40	+44 00 14.0	2000	14.99	Syft
Q110	HD125162	14 14 30.00	+46 20 0.0	7000	4.18	A0p
P102	HD124314	14 15 1.60	-61 42 24.0	2100	6.64	O6Vnf
P104	HD124897	14 15 43.50	+19 12 37.0	10000	-0.04	K1III
P101	NGC5548	14 17 59.50	+25 08 13.0	33600	13.10	Syft1
P102	HD124979	14 18 11.90	-51 30 13.0	3800	7.80	O8.5V
P101	HD125924	14 22 42.90	-08 14 53.0	1200	9.68	B2IV
P132	PG1424+535	14 25 55.50	+53 15 24.0	4000	16.20	DOZ1
P101	MRK1383	14 29 6.40	+01 17 6.0	26100	14.80	Syft1
P186	PROX-CEN	14 29 42.90	-62 40 47.0	2000	11.05	M5Ve
P108	MRK817	14 36 22.10	+58 47 39.0	200000	14.50	Syft1.5
P186	HD129333	14 39 1.10	+64 17 32.7	4650	7.54	G0V
P104	HD128621	14 40 0.70	-60 50 38.0	33000	1.33	K1V
P104	HD128620	14 40 0.80	-60 50 42.0	22000	-0.01	G2V
P111	MRK477	14 40 38.06	+53 30 15.7	10000	15.90	AGN
P111	MRK478	14 42 7.46	+35 26 22.9	8000	14.60	AGN
P107	PG1444+407	14 46 45.90	+40 35 6.0	2000	15.95	QSO

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P153	XI-BOOA	14 51 23.00	+19 06 7.0	8000	4.60	G8V
Q109	H1504+65	15 02 8.00	+66 12 26.0	11000	16.30	PG1159
P114	SMSTAR	15 02 53.10	-41 59 16.5	36000	16.70	sdOB
P102	HD132960	15 03 20.80	-41 16 17.0	300	7.39	B1IV
P107	MRK841	15 04 1.20	+10 26 16.0	2000	14.00	Syft1
P102	HD134411	15 11 8.80	-39 51 50.0	1100	9.56	B2V
P132	PG1520+525	15 21 46.90	+52 22 4.3	2000	15.52	DOZ1
P107	MRK290	15 35 52.40	+57 54 9.0	2000	15.21	Syft1
P107	MRK487	15 37 4.20	+55 15 48.0	2000	15.45	Gal
P193	HD138403	15 37 11.60	-71 54 53.0	2000	10.47	CSPN
P104	HD140436	15 42 44.90	+26 17 42.0	2000	3.84	B9IV+A3V
P108	HS1543+5921	15 44 20.10	+59 12 26.0	200000	16.40	QSO
P104	HE2-138	15 56 1.30	-66 09 7.0	5200	10.90	CSPN
P119	HD143939	16 04 44.40	-39 26 4.0	5000	7.10	B9p
P186	HD144668	16 08 34.20	-39 06 0.0	3825	7.05	A7IVe
P107	MRK876	16 13 57.20	+65 43 10.0	2000	15.23	Syft1
P101	HD146813	16 15 14.70	+55 47 58.0	1300	9.07	B1.5
Q110	WD1620-391	16 20 12.00	-39 07 0.0	1000	11.00	WD
P116	HD147889	16 22 22.82	-24 21 7.2	12600	7.92	B2IV
P107	PG1626+554	16 27 55.90	+55 22 31.0	2000	16.17	QSO
P112	ABELL2199	16 28 38.25	+39 33 4.3	40000	0.00	CLUS
P104	WD1631+781	16 29 11.10	+78 04 41.0	30000	13.28	WD
P101	HD148422	16 30 59.80	-56 29 42.0	6400	8.60	B1Ia
P116	HD147888	16 35 24.17	-23 27 36.3	6300	6.74	B3/B4V
P116	HD149404	16 36 22.44	-42 51 31.8	16600	5.47	O9I
Q103	EUVEJ1636-285	16 36 34.00	-28 32 0.0	4000	0.00	NoID
P101	HD149881	16 36 58.10	+14 28 31.0	300	7.03	B0.5III
P104	HD149499B	16 38 30.00	-57 28 12.0	4000	11.70	WD
P101	BARNARD29	16 41 34.00	+36 26 6.0	7400	13.14	PAGB
P101	CPD-74D1569	16 50 50.00	-74 32 20.0	1700	10.15	O9.5V
P102	HD151805	16 51 35.60	-41 46 36.0	7200	8.91	B1IB
P117	HD151932	16 52 19.10	-41 51 16.0	600	6.49	WN7
P107	MRK501	16 53 52.20	+39 45 37.0	2000	14.15	BLLac
P116	HD152236	16 53 59.61	-42 21 43.2	14100	4.73	B1Iape
P101	HD152218	16 53 59.90	-41 42 53.0	5900	7.61	O9.5IVn
P102	HD152233	16 54 3.30	-41 47 29.0	1400	6.56	O6IIIfp
P102	HD152248	16 54 9.80	-41 49 31.0	1400	6.10	O7Ibnfp
P102	HD152314	16 54 31.80	-41 48 19.0	4900	7.54	O9.5III-IV
P102	HD152623	16 56 14.90	-40 39 36.0	950	6.73	O7Vnf
P102	HD152723	16 56 54.50	-40 30 43.0	7100	7.10	O6.5IIIf
P166	HER-X-1	16 57 49.70	+35 20 33.0	10000	13.90	DA
P110	HS1700+6416	17 01 0.48	+64 12 8.9	500000	16.10	QSO
P102	HD153426	17 01 12.90	-38 12 13.0	4200	7.47	O9II-III
Q106	3C351	17 04 41.50	+60 44 28.0	18000	15.30	QSO
P116	HD154368	17 06 28.28	-35 27 4.0	2000	6.13	O9Ia
P132	PG1707+427	17 08 47.70	+42 40 59.6	13000	16.40	DOZ1
P102	HD155775	17 15 22.10	-38 12 46.0	430	6.67	B0.5III
P101	HD156359	17 16 36.60	-62 52 6.0	2100	9.68	O9.7Ib-II
P102	HD156292	17 18 45.60	-42 53 30.0	10000	7.49	O9.5III
P117	HD156385	17 19 29.80	-45 38 24.0	300	7.45	WC7
P107	MRK506	17 22 40.00	+30 52 53.0	2000	15.12	Syft1.5
P107	4C+34.47	17 23 20.80	+34 17 58.0	2000	16.50	QSO

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P102	HD157857	17 26 17.30	-10 59 34.0	4100	7.78	O6.5IIIf
P118	HD159181	17 30 26.00	+52 18 10.3	2220	2.79	G2Iab
P101	HD158243	17 31 7.00	-53 28 43.0	2800	8.15	B1Iab
P122	HD158661	17 31 12.70	-17 08 32.0	12200	8.20	B0.5Ib
Q119	HD158643	17 31 24.80	-23 57 44.0	18000	4.80	A0V
P101	HD160993	17 45 17.60	-45 38 13.0	2000	7.73	B1Iab
P198	HEN2-274	17 45 35.30	-46 05 25.0	4000	11.40	CSPN
P122	HD161807	17 49 24.60	-38 59 0.0	300	6.99	B0IIIn
Q108	NGC6543	17 58 33.30	+66 37 59.2	1000	11.10	CSPN
P101	HD163522	17 58 35.10	-42 29 10.0	2700	8.46	B1Ia
P102	HD163892	17 59 26.20	-22 28 1.0	1500	7.44	O9IVn
P101	HD163758	17 59 28.20	-36 01 16.0	2400	7.32	O6Ia
P117	HD164270	18 01 43.00	-32 42 54.0	2000	9.01	WC9
P107	KAZ102	18 03 28.80	+67 38 10.0	2000	15.78	Syft1
P116	HD164740	18 03 40.30	-24 22 44.0	3000	10.33	O7.5V
P101	HD164816	18 03 56.80	-24 18 45.0	600	7.08	O9.5III-IV
P102	HD164906	18 04 25.80	-24 23 10.0	1900	7.47	B1IVpe
P122	HDE315021	18 04 35.80	-24 19 52.0	1900	8.57	B1V
P102	HD165052	18 05 10.50	-24 23 55.0	630	6.87	O6.5Vnf
P105	HD165246	18 06 4.60	-24 11 44.0	5000	7.71	O8Vn
P117	HD165763	18 08 28.30	-21 15 11.0	300	8.25	WC5
P102	HD165955	18 09 57.70	-34 52 7.0	2300	9.19	B3Vn
P122	HD166546	18 11 57.00	-20 25 25.0	570	7.24	O9.5III
P105	HD166716	18 12 28.40	-15 22 24.0	5400	8.00	B0II-II
P192	AS-292	18 14 10.00	-32 47 32.0	16000	9.70	K5
P122	HD167287	18 15 16.60	-18 59 33.0	510	7.09	B1Ib
P101	LS4825	18 16 0.40	-30 45 46.0	20000	11.99	B1Ib-II
P184	AM-HER	18 16 13.30	+49 52 4.0	2000	12.30	CV
P101	HD167402	18 16 18.50	-30 07 29.0	2300	8.95	B0Ib
P102	HD167659	18 16 58.50	-18 58 5.0	4200	7.39	O7IIf
P102	HD167771	18 17 28.40	-18 27 48.0	620	6.52	O7IIInf
P116	HD167971	18 18 5.76	+59 42 2.3	8300	7.31	B0V
P116	HD168076	18 18 36.33	-13 48 2.4	2000	8.21	O5f
P101	HD167756	18 18 39.90	-42 17 18.0	300	6.30	B0.5Ia
P122	HD168080	18 18 46.70	-18 10 20.0	2400	7.61	B0.5II
P101	H1821+643	18 21 57.00	+64 20 36.0	56800	14.20	QSO
P101	HD168941	18 23 25.50	-26 57 11.0	6400	9.34	O9.5II-III
P105	HD169673	18 26 23.60	-15 37 48.0	4800	7.34	B1II
P107	3C382	18 35 3.40	+32 41 47.0	2000	15.50	Syft1
Q108	IRAS18333-2357	18 36 23.30	-23 55 20.0	4000	14.30	CSPN
P104	HD172167	18 36 56.40	+38 46 47.0	20000	0.03	A0V
P101	HD172140	18 39 48.20	-29 20 21.0	3100	9.96	B0.5III
P133	IC4776	18 45 51.10	-33 20 40.0	5000	14.10	WC6
P101	HD173502	18 46 55.70	-29 57 35.0	2100	9.68	B0.5III
Q113	V603-AQL	18 48 54.60	+00 35 2.9	6000	11.90	CV
P101	HD175754	18 57 35.60	-19 09 11.0	300	7.01	O8IIf
P101	HD175876	18 58 10.70	-20 25 25.0	300	6.94	O6III
P119	HD176386	19 01 38.80	-36 53 26.0	14000	7.20	B9IV
P104	HD177756	19 06 14.90	-04 52 53.0	2000	3.44	B9Vn
P101	HD177566	19 07 7.60	-41 43 10.0	700	10.20	PAGB
P101	HD177989	19 07 36.50	-18 43 30.0	2100	9.33	B0III

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P101	HD178487	19 09 14.70	-10 13 4.0	8800	8.66	B0Ib
P101	HD179407	19 12 52.90	-12 34 57.0	10800	9.41	B0.5Ib
P101	HD181653	19 16 24.16	+67 08 6.0	300	8.40	B1II-III
P101	E141-55	19 21 14.10	-58 40 13.0	100300	13.60	Syft1
P101	HD183899	19 32 45.10	-26 09 46.0	5700	9.80	B2III
P116	HD185418	19 38 27.39	+17 15 26.3	2000	7.45	B0.5V
P122	HDE332407	19 41 19.80	+29 08 40.0	12600	8.50	B1Ib
P193	HD186924	19 44 48.14	+50 31 31.6	2000	10.50	CSPN
P101	HD225757	19 46 41.60	+34 39 14.0	7400	10.59	B1IIIn
P187	V3885-SGR	19 47 40.30	-42 00 28.0	12000	10.00	CV
P117	HD187282	19 48 32.20	+18 12 7.0	2000	10.56	WN4
P102	HD187459	19 48 50.50	+33 26 14.0	1600	6.48	B0.5Ib
P118	HD187642	19 50 45.10	+08 51 46.6	2000	0.77	A7V
P102	HD188001	19 52 21.70	+18 40 19.0	300	6.25	O7.5Iaf
P104	GCRV12336	19 59 36.10	+22 43 0.0	5200	13.94	CSPN
P102	HD190429	20 03 29.30	+36 01 30.0	2300	6.63	O4If
P102	HD190918	20 05 57.40	+35 47 18.0	1800	6.80	O9.5Iab/WN4
P122	HD191495	20 08 53.50	+35 30 46.0	5700	8.26	B0V
P107	PKS2005-489	20 09 25.40	-48 49 54.0	2000	15.30	BLLac
P117	HD191765	20 10 14.10	+36 10 36.0	1400	8.31	WN6
P102	HD192035	20 10 49.40	+47 48 48.0	6800	8.18	B0III-IV
P102	HD191877	20 11 21.00	+21 52 31.0	300	6.26	B1Ib
P117	HD192103	20 11 53.50	+36 11 51.0	1000	8.09	WC8
P164	31CYG	20 13 37.90	+46 44 28.8	2000	3.79	ZAUR
P116	HD192639	20 14 30.32	+37 21 14.2	15000	7.11	O8e
P164	32CYG	20 15 28.30	+47 42 51.1	6000	3.98	ZAUR
P117	HD193077	20 17 0.10	+37 25 25.0	2000	7.97	WN5
P101	HD195455	20 32 14.60	-24 04 3.0	1000	9.20	B0.5III
P102	HD195965	20 32 25.50	+48 12 59.0	340	6.98	B0V
P104	HD196867	20 39 38.00	+15 54 43.0	2000	3.77	B9IV
P108	MRK509	20 44 9.80	-10 43 23.0	200000	13.00	Syft1
P118	HD197481	20 45 8.30	-31 20 9.2	15000	8.61	M0Ve
P114	CYGLP-W1	20 45 38.37	+31 06 32.6	8000	0.00	SNR
P114	CYGLP-W2	20 45 38.68	+31 06 32.6	8000	0.00	SNR
P101	BD+35D4258	20 46 12.50	+35 32 26.0	7400	9.35	B0.5Vn
P114	CYGLP-NE4	20 56 2.53	+31 56 36.5	8000	0.00	SNR
P114	CYGLP-NE3	20 56 2.60	+31 56 37.4	8000	0.00	SNR
P114	CYGLP-NE2	20 56 2.67	+31 56 38.3	8000	0.00	SNR
P114	CYGLP-NE1	20 56 2.74	+31 56 39.2	8000	0.00	SNR
P116	HD199579	20 56 34.67	+44 55 29.4	2000	6.01	O6Ve
P114	CYGLP-E1	20 57 21.34	+31 05 42.6	8000	0.00	SNR
P114	CYGLP-E2	20 57 22.85	+31 06 1.7	8000	0.00	SNR
P104	HD200516	21 04 10.80	-11 21 48.0	3500	12.78	CSPN
P122	HD201345	21 07 55.30	+33 23 50.0	300	7.66	O9Vp
P101	HD201638	21 09 53.00	+35 29 31.0	1700	9.10	B0.5Ib
P104	WD2111+498	21 12 43.50	+50 06 17.0	38000	13.09	WD
P102	HD202347	21 13 41.80	+45 36 41.0	300	7.51	B1.5V
P132	WD2117+341	21 17 6.20	+34 12 15.4	8000	13.30	DOZ1
P101	HD203664	21 23 28.70	+09 55 55.0	400	8.59	B0.5V
P102	HD203699	21 23 35.20	+14 03 1.0	320	6.86	B2.5IVne
P116	HD203938	21 23 50.06	+47 09 52.6	7600	7.45	B0.5V

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P101	HD204076	21 27 1.00	-31 56 21.0	1300	8.79	B1V
P133	K648	21 29 59.40	+12 10 26.0	8200	15.00	sdO
P101	IIZW136	21 32 27.80	+10 08 17.0	53000	14.60	Syft1
P101	BD+48D3437	21 36 15.80	+49 20 57.0	9600	8.69	B1Iab
P104	NGC7094	21 36 53.00	+12 47 20.0	8700	13.68	CSPN
P116	HD206267	21 38 57.54	+57 29 20.8	2300	5.62	O6e
P116	HD207198	21 44 53.22	+62 27 38.3	12500	5.95	O9IIe
P116	HD207538	21 47 39.67	+59 42 2.3	10000	7.31	B0V
Q111	AG-PEG	21 51 2.00	+12 37 32.0	2000	9.40	SYMB
P164	VV-CEP	21 56 39.10	+63 37 32.0	6000	4.91	VVCEP
P108	PKS2155-304	21 58 51.80	-30 13 30.0	200000	13.09	BLLac
P193	HD218066	22 04 2.11	+63 23 48.6	4000	7.62	B1V
P118	HD209750	22 05 46.90	-00 19 11.1	15625	2.90	G2Ib
P116	HD210121	22 08 11.76	-03 31 52.9	15000	7.67	B3V
P153	AR-LAC	22 08 41.00	+45 44 29.0	32000	6.10	K0IV
P116	HD210839	22 11 30.60	+59 24 52.7	4000	5.06	O6Iab
P122	HD210809	22 11 38.50	+52 25 48.0	1300	7.57	O9Iab
P122	BD+53D2820	22 13 49.50	+54 24 35.0	9000	9.95	B0IVn
P104	WD2211-491	22 14 12.30	-49 19 2.0	4000	11.71	WD
P122	HDE235783	22 17 6.90	+54 30 28.0	14100	8.68	B1Ib
P107	MRK304	22 17 12.20	+14 14 21.0	2000	15.08	Syft1
P122	HD212044	22 20 22.60	+51 51 40.0	550	6.98	B1V
P122	BD+52D3210	22 26 54.30	+53 38 42.0	6000	10.69	B1V
P122	BD+53D2885	22 27 7.30	+54 10 54.0	12000	10.46	B2III
P198	NGC7293	22 29 38.50	-20 50 18.0	2000	13.50	CSPN
P122	HDE235874	22 32 59.70	+51 12 56.0	4900	9.64	B3III
P101	HD214080	22 36 6.31	-16 23 16.0	300	6.80	B1Ib
P104	HD214923	22 41 27.40	+10 49 53.0	2000	3.40	B8V
P101	HD215733	22 47 2.40	+17 14 0.0	300	7.34	B1II
P122	HD216044	22 48 43.20	+55 07 34.0	5800	8.51	B0II
P122	HD216438	22 51 58.20	+53 42 35.0	4700	8.46	B1II
P111	MR2251-178	22 54 5.80	-17 34 55.0	9000	14.40	QSO
P193	HD217312	22 58 39.67	+63 04 37.8	4000	7.41	B0IV
P101	NGC7469	23 03 15.60	+08 52 26.0	33600	13.00	Syft1
P111	NGC7469	23 03 15.60	+08 52 26.0	16000	13.00	AGN
P107	MRK926	23 04 43.40	-08 41 8.0	2000	14.50	Syft1.5
P104	HD218045	23 04 45.40	+15 12 21.0	2000	2.45	B9V
P107	NGC7496	23 09 47.30	-43 25 40.0	2000	11.91	Syft2
P101	HD218915	23 11 6.90	+53 03 30.0	1000	7.20	O9.5Iab
P104	GD246	23 12 21.00	+10 47 0.0	19000	13.10	WD
P101	HD219188	23 14 0.50	+04 59 50.0	300	6.93	B0.5II-III
P122	HD220057	23 20 0.60	+61 09 0.0	920	6.93	B3IVsb
P112	ABELL2597	23 25 19.72	-12 07 27.0	40000	0.00	CLUS
P132	HS2324+3944	23 27 15.70	+40 01 22.0	2000	14.80	DOZ1
P104	WD2331-475	23 34 1.20	-47 13 55.0	19000	13.44	WD
P179	HD222107	23 37 33.90	+46 27 29.0	8550	3.70	G8IV
P110	HE2347-4342	23 50 34.24	-43 26 0.0	500000	16.00	QSO
P107	PG2349-014	23 51 56.10	-01 09 13.0	2000	15.33	Syft1
P179	HD224085	23 55 1.80	+28 37 59.0	3600	7.20	K2IV
P122	HD224151	23 55 33.70	+57 24 44.0	1600	6.01	B0.5II-III
P105	HD224257	23 56 24.90	+55 59 26.0	1100	8.00	B0.2IV

Prog ID	Target Name	RA (2000.0)	DEC (2000.0)	Exposure Time (s)	V	Object Type
P105	OVIFOLLOWUP	99 99 99.90	-99 99 99.0	300000	9.99	Many*s
P106	OVIFOLLOWUP	99 99 99.90	-99 99 99.0	300000	9.99	Many*s
P109	JUPITER	99 99 99.90	-99 99 99.0	72000	9.99	SOL
P180	COMET-TOO	99 99 99.90	-99 99 99.0	25000	9.99	SOL
P120	IO-TORUS-MDRS	99 99 99.99	-99 99 99.9	20000	9.99	SOL
P120	IO-TORUS-LWRS	99 99 99.99	-99 99 99.9	20000	9.99	SOL
P120	JUPITER-AURORA	99 99 99.99	-99 99 99.9	12000	9.99	SOL
P120	JUPITER-CENTER	99 99 99.99	-99 99 99.9	20000	9.99	SOL
P120	SATURN	99 99 99.99	-99 99 99.9	12000	9.99	SOL
P120	VENUS	99 99 99.99	-99 99 99.9	10000	9.99	SOL

FUSE Calibration Target List

The following listing shows the pre-launch expected FUSE calibration targets. These targets are not in general reserved for use by the PI team unless they also appear in Appendix D. For convenience, targets in this category are indicated with an asterisk (*) in the first column.

The information listed below includes the Program Identification (PID), the target name, J2000 equatorial coordinates, cumulative exposure time planned for Cycle 1, which may include multiple visits, V magnitude, and an indicator of the spectral type. The PID permits cross-referencing of target to its **primary** calibration program, as indicated below.

PID	Target Name	RA(J2000)	DEC(J2000)	Cumulative Exposure Time (s)	Target V	Target Type
*M107	WD0005+5106	00 08 18.10	+51 23 17.0	2000	13.32	DO1
M103	BD-12D134	00 47 3.30	-11 52 19.0	300	11.78	DOZ1
M101	GD659	00 53 17.20	-32 59 58.0	7800	13.37	DA1
M102	BPM70524	01 03 25.00	-06 32 12.0	13000	13.30	DB
M102	BPM17088	03 08 30.00	-56 34 0.0	13000	14.07	DB
*M103	NGC1360	03 33 14.70	-25 51 19.0	300	11.35	sdO
*M107	LSV46-21	04 43 21.00	+46 42 4.0	2000	12.90	DAO
M103	RE0503-289	05 03 55.90	-28 54 36.0	900	13.90	DO1
*M101	G191-B2B	05 05 30.60	+52 49 54.0	2000	11.78	DA1
M101	GD71	05 52 27.40	+15 53 23.0	12000	13.03	DA1
M104	BD+75D325	08 10 49.30	+74 57 57.5	2300	9.55	sdO
M103	AGK+81D266	09 21 19.30	+81 43 30.5	400	11.85	sdO
*M103	PG1034+001	10 37 4.00	-00 08 20.4	360	13.19	DO1
M103	FEIGE-34	10 39 36.70	+43 06 10.1	300	11.12	DO
M103	HZ21	12 13 56.50	+32 56 28.3	2400	14.22	DO1
M103	FEIGE-66	12 37 23.60	+25 04 0.3	300	10.51	sdO
M103	FEIGE-67	12 41 51.80	+17 31 20.5	300	11.81	sdO
M101	GD153	12 57 2.40	+22 01 56.0	4800	13.35	DA1
*M101	HZ43	13 16 22.00	+29 05 57.0	2000	12.91	DA1
M104	HZ44	13 23 35.40	+36 08 0.0	20880	11.71	sdO
M102	GD190	15 44 19.00	+18 16 18.0	20000	14.72	DB
*M103	HD149499B	16 38 30.50	-57 28 11.0	300	11.70	DO1
M104	BD+28D4211	21 51 11.10	+28 51 51.8	2400	10.51	sdO
*M103	WD2211-495	22 14 12.30	-49 19 2.0	300	11.50	DA1
*M101	GD246	23 12 21.40	+10 47 5.0	2000	13.08	DA1
M103	FEIGE-110	23 19 58.40	-05 09 55.8	330	11.50	sdO

Notes:

1. With the exception of program M101, not all stars shown will be observed.
2. In the other programs a large number of stars are included for purposes of scheduling convenience.
3. Stars identified with a given program may be used for other programs, but are listed only once in the target list.
4. Many of the objects shown will also be used for additional calibration programs, such as measurements of mirror and grating scattering, focusing, FES photometric calibration, etc.

The calibration program IDs are the following:

M101: Photometric calibration, defined by DA white dwarfs (4" slit).
M102: Photometric calibration, definition, objects without Lyman lines (DB white dwarfs)
M103: Photometric calibration, monitoring by DO white dwarfs, G191, sdO stars (4" slit)
M104: Flat field, done by FP-splits of DO white dwarfs, sdO stars (1.25" slit) exposure times include 4 separate exposures
M106: Wavelength calibration, emission-line objects
M107: Wavelength calibration, absorption-line objects

FUSE PI Science Team Science Program Abstracts for Cycle 1

Given below is a list summarizing the FUSE PI Team Science Program IDs, contact people, and program titles. This is followed by a text section with abstracts for each science program. The Program identifiers cross reference to the target listing provided in Appendix D.

FUSE PI Team Science Program Summary Listing

Program ID	Program Contact	Program Title
Major Programs		
P101	Sembach	The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Galactic Halo)
P102/P122	Sembach	The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Galactic Disk)
P103	Sembach	The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Magellanic Clouds)
P104	Sembach	Deuterium Abundances and the D/H Ratio (Local ISM)
P105	Sembach	Deuterium Abundances and the D/H Ratio (Galactic Disk)
P106	Sembach	Deuterium Abundances and the D/H Ratio (Galactic Halo)
P107	Sembach	Deuterium Abundances and the D/H Ratio (Snapshot Survey)
P108	Sembach	Deuterium Abundances and the D/H Ratio (Extragalactic)
P109	Sembach	Deuterium Abundances and the D/H Ratio (Solar System)
P110	Kriss	FUSE Studies of the Intergalactic Medium
FUSE Science Team Small and Medium Programs		
P111	Kriss	Active Galactic Nuclei
P112	Oegerle	O VI in Cooling Flow Clusters
P113	Sonneborn	Circumstellar Interaction in SN 1987A
P114	Blair	Supernova Remnants
P115	Shull	Diffuse Molecular Hydrogen
P116	Snow	Molecular Hydrogen in Translucent Clouds
P117	Hutchings	Hot Stars
P118	Linsky	FUV Spectroscopic Survey of Cool Stars
P119	Vidal-Madjar	Circumstellar Disks
P120	Feldman	Solar System Objects

FUSE/Johns Hopkins Univ. Instrument and Operations Team Projects

P131	Friedman	Small-Scale Structure in the ISM
P132	Kruk	PG1159 Stars
P133	Bianchi	Planetary Nebulae Central Stars
P134	Murphy	Search for O VI Emission in the Halo of NGC 4631
P135	Ake	Epsilon Aurigae

FUSE/U.C. Berkeley Instrument Team Projects

P151	Welsh	Supernova Remnant Absorption Studies
P152	Welsh	Herbig Be stars
P153	Griffiths	Active Late-Type Stars
P154	Siegmund	Flare Activity in Cataclysmic Variable Systems

FUSE/Univ. of Colorado Instrument Team Projects

P163	Wilkinson	T Tauri Stars
P164	Wilkinson	Zeta Aur Systems
P166	J. Green	X-ray Binaries

FUSE Co-Investigator Projects

P179	Dupree	Atmospheres of Cool Star Binaries
P180	Feldman	Target of Opportunity Observations of Comets
P184	Hutchings	Stellar Winds and CVs
P186	Linsky	Transition Regions of PMS and Pleiades Age Stars
P187	Malina	Pulsar and CV Observations
P191	Shull	Lyman Break in Star-Forming Galaxies
P192	Siegmund	T-Tauri Stars
P193	Snow	Studies of IS and CS Gas and Dust
P198	Vidal-Madjar	Blue Compact Galaxy and CSPN

FUSE French Guaranteed Time Projects

Q101	Gry	H2 Associated with Dust Color Variations
Q103	Vidal-Madjar	He I in the Local ISM
Q105	Deharveng	Lyman Break in Star-Forming Galaxies
Q106	LeBrun	O VI Phase in Galactic Haloes
Q107	Ferlet	H2 in the Small Magellanic Cloud
Q108	Vidal-Madjar	Central Stars of Planetary Nebulae
Q109	Vidal-Madjar	Peculiar White Dwarfs
Q110	Vidal-Madjar	Quasi-Molecular Satellite Lines in Lyman Beta
Q111	Ferlet	The Symbiotic Binary IX Velorum
Q112	Ferlet	Cataclysmic Binaries
Q113	Ferlet	The Old Nova V603 Aql
Q114	Ferlet	Be Stars
Q119	Deleuil	Circumstellar Disks

Abstract listings

Major Program: The Properties of Hot Gas in the Milky Way and Magellanic Clouds

The FUSE PI and Science Team will study the physical properties and distribution of hot gas in the interstellar media of the Milky Way and Magellanic Clouds through comprehensive absorption line studies of the O VI doublet and lower ionization lines in the FUSE bandpass. O VI is the best diagnostic of hot (log T = 5-6) gas in the ultraviolet spectral region. These observations will be covered under Team programs P101 (O VI Galactic Halo), P102/122 (O VI Galactic Disk), and P103 (O VI Magellanic Clouds).

The Team D/H and O VI programs will share data. Note that the exposure times given in this NRA listing for sight lines toward hot stars in P101, P102/122, and P103 are appropriate for S/N ~30 at full resolution (0.03 A) at 1032 A. Extragalactic sight line integrations in P101 will have S/N ~12-30. D/H observations of some objects in the O VI program will be several times longer than the listed integrations.

Program_ID: P101
Program_title: The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Galactic Halo)
Program_contact: Sembach
Program_abstract: This portion of the O VI program will focus on understanding the character of the O VI absorption in the Galactic halo along sight lines toward stars and extragalactic continuum sources such as AGNs and QSOs. Regions to be explored include the Galactic poles, the inner Galaxy, and the outer regions of the Milky Way halo. The data obtained for this program will be integrated with existing information from previous space missions to provide a global picture of the hot gas content of the Milky Way halo. A portion of the time for this program will be used to make measurements of the O VI emission from the diffuse halo gas, though this is a secondary objective since such measurements depend sensitively on instrument performance. There will be a large amount of auxiliary information obtained as part of the O VI halo program. The Science Team will rely heavily upon these data to undertake additional investigations of the chemical composition and physical properties of the ISM, the properties of hot stars and their winds, and the far-UV continua and absorption line properties of AGNs and QSOs. Data from this program will also be used as a snapshot for determining which extended sight lines are best suited for follow-up studies of the D/H ratio. (See abstracts for programs P104, P105, P111, P115, and P117 for additional details.)

Program_ID: P102
Program_title: The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Galactic Disk)
Program_contact: Sembach
Program_abstract: This portion of the O VI program will focus on understanding the character of the O VI absorption in the Galactic disk at distances greater than ~ 1 kpc from the Sun. The survey will provide information for a statistical study of the O VI absorption properties as well as detailed studies of regions already known to contain hot gas through X-ray emission measurements (e.g., SNRs, radio continuum loops). Local interstellar medium data from the D/H program will be used to understand the properties of the hot gas in the solar neighborhood. There will be an additional "mini-survey" of several binary systems at multiple epochs to search for the presence of broad shallow O VI absorption due to very hot interstellar gas through a precise tomographic reconstruction of the stellar absorption in the vicinity of the O VI lines. The Team will also check for variability in the stellar O VI lines by observing several objects with a range of spectral types several times during the mission. There will be a large amount of auxiliary information obtained as part of the O VI disk program. The Science Team will rely heavily upon these data to undertake additional investigations of the chemical composition and physical properties of the ISM and the properties of hot stars and their winds. Data from this program will also be used as a snapshot for determining which extended sight lines are best suited for follow-up studies of the D/H ratio. (See abstracts for programs P104, P105, P115, and P117 for additional details.)

Program_ID: P122
Program_title: The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Galactic Disk)--continuation
Program_contact: Sembach
Program_abstract: Program P122 is a continuation of program P102.

Program_ID: P103
Program_title: The Properties of Hot Gas in the Milky Way and Magellanic Clouds (Magellanic Clouds)
Program_contact: Sembach
Program_abstract: This portion of the O VI program will focus on understanding the character of the O VI absorption in the Magellanic Clouds. Approximately 20 sight lines will be investigated in the two galaxies. The sight lines will include superbubble structures with strong X-ray emission and field positions with little X-ray emission. The hot gas properties of the LMC and SMC will be compared to those derived for the Milky Way. There will be a large amount of auxiliary information obtained as part of the O VI Magellanic Cloud program. The Science Team will rely heavily upon these data to undertake additional investigations of the chemical composition and physical properties of the ISM in the Milky Way and Magellanic Clouds, as well as the properties of hot stars and their winds (See abstract for programs P115 and P117 for additional details.)

Major Program: Deuterium Abundances and the D/H Ratio

The FUSE PI and Science Team will determine the abundance of deuterium and the D/H ratio in a variety of galactic environments through comprehensive absorption line studies of the D I and H I Lyman series lines in the FUSE bandpass. The sight lines studied will have varying degrees of metallicity and different evolutionary histories. Various metallicity markers (e.g., Oxygen, Iron) and ancillary ISM information (elemental abundances, physical conditions, and gas kinematics) will be integral components of all D/H analyses undertaken by the Team. The sky coverage of these observations will be maximized to the greatest extent possible. The D/H program encompasses Team programs P104 (D/H Local ISM), P105 (D/H Galactic Disk), P106 (D/H Galactic Halo), P107 (D/H Snapshot Survey), P108 (D/H Extragalactic), and P109 (D/H Solar System).

Program_ID: P104
Program_title: Deuterium Abundances and the D/H Ratio (Local ISM)
Program_contact: Sembach
Program_abstract: This portion of the D/H program will provide information for sight lines confined to the local interstellar medium to determine the extent to which the D/H ratio varies within a few hundred parsecs of the Sun. These observations will significantly increase the amount of information available for local deuterium abundance determinations and will enhance the information for the local interstellar medium available from earlier Copernicus satellite studies. Objects to be used as background sources include cool stars, white dwarf stars, the central stars of planetary nebulae, and a few A-type stars. Auxiliary uses for the data will include general ISM studies and a survey of hot gas within the Local Bubble. (See abstracts for programs P102/122 and P115 for additional details.)

Program_ID: P105
Program_title: Deuterium Abundances and the D/H Ratio (Galactic Disk)
Program_contact: Sembach
Program_abstract: This portion of the D/H program will provide information for sight lines that extend beyond the local interstellar medium of the Galactic disk. The sight lines covered will sample gas in spiral arm and interarm directions several kiloparsecs from the Sun. Most of the objects observed will be OB-type stars. Data from program P102/122 (O VI disk survey) will provide an initial far-UV observation of a large number of sight lines. Many of these sight lines will be re-observed for longer integration times (a factor of 3-5x) as part of this program. All of the P102/P122 sight lines should be considered potential candidates for this study.

Program_ID: P106
Program_title: Deuterium Abundances and the D/H Ratio (Galactic Halo)
Program_contact: Sembach
Program_abstract: This portion of the D/H program will provide information for sight lines that extend into the Galactic halo. The directions to be studied include sight lines toward stars at the Galactic poles as well as toward stars in the inner and outer regions of the Galaxy. Most of the objects observed will be OB-type stars. Data from program P101 (O VI halo survey) will

provide an initial far-UV observation of a large number of sight lines. Many of these sight lines will be re-observed for longer integration times (a factor of 3-5x) as part of this program. All of the P101 sight lines should be considered potential candidates for this study.

Program_ID: P107
Program_title: Deuterium Abundances and the D/H Ratio (Snapshot Survey)
Program_contact: Sembach
Program_abstract: This portion of the D/H program will provide short observations of many AGNs and QSOs to check far ultraviolet flux levels and suitability of the objects as background continuum sources for extended integrations. The data produced from this snapshot survey will be used extensively as part of program P111 to study the flux distribution and intrinsic absorption properties of the AGNs and QSOs observed. (See abstract for program P111 for more information.) The Team will also use this data for studies of extragalactic O VI and H I absorption at low redshift.

Program_ID: P108
Program_title: Deuterium Abundances and the D/H Ratio (Extragalactic)
Program_contact: Sembach
Program_abstract: This portion of the D/H program will provide extended observations of extragalactic continuum sources for measurements of the D/H ratio in the distant Galactic halo, high velocity clouds, and low redshift ($z < 0.3$) absorption systems. These observations will provide unique opportunities to measure the deuterium abundance in places that are difficult to observe through absorption line studies of sight lines toward hot stars. Data from this program will be used by program P111 for high quality measurements of the far-UV continuum and absorption properties of AGNs and QSOs. (See abstract for program P111 for more information.)

Program_ID: P109
Program_title: Deuterium Abundances and the D/H Ratio (Solar System)
Program_contact: Sembach
Program_abstract: This portion of the D/H program will focus on determining the D/H ratio on Jupiter. The observation will consist of several planetary limb pointings. The Jupiter D/H measurement will provide a reference value for the ratio at the time the solar system was formed about 5 billion years ago.

<u>Major Program: FUSE Studies of the Intergalactic Medium</u>

Program_ID: P110
Program_title: FUSE Studies of the Intergalactic Medium
Program_contact: Kriss
Program_abstract: FUSE will provide an opportunity to explore absorption by He II in the intergalactic medium (IGM) over the redshift range z=2-3. The planned observations will measure the mean opacity of the IGM in coarse bins over this redshift interval to study the patchiness of the IGM over different lines of sight as a function of redshift. Deep observations

of one or more candidate QSOs will attempt to resolve the He II Ly alpha forest. These observations will discriminate between discrete structures and distributed gas as sources of the He II opacity. Detailed comparisons of the He II forest lines and the H I Ly alpha forest lines will be used to determine the ionization state of the absorbing structures and the shape of the ionizing UV background spectrum.

FUSE Science Team Small and Medium Programs

Program_ID: P111
Program_title: Active Galactic Nuclei
Program_contact: Kriss
Program_abstract: The nearest, brightest active galaxies have inspired our current vision of the AGN paradigm. These same galaxies have been imaged with HST, have the highest S/N HST and IUE far-UV spectra, and have the best X-ray spectra. Prime goals for FUSE observations are the shape of the far-UV continuum, the strength and velocity of the O VI emission line, strengths of other far-UV lines such as C III 977 and N III 991, and the prevalence of intrinsic absorption and Lyman limits. FUSE observations will resolve velocity structure in the O VI absorbing gas, and in any neutral hydrogen gas. Observations of Seyfert 2s (in addition to NGC 1068) will search for strong line emission in O VI, C III, and N III indicative of shock-heated gas. FUSE will also be sensitive to any molecular gas (visible as H_2 absorption) along the line of sight. In BAL QSOs, FUSE will be able to measure the absorption in the EUV transitions of high ionization ions such as Si XII. The detailed observations of selected objects in this program will supplement the more general surveys of AGN being used to explore O VI absorption and the D/H ratio in the galactic halo.

Program_ID: P112
Program_title: O VI in Cooling Flow Clusters
Program_contact: Oegerle
Program_abstract: We will search for the O VI 1032/1038 emission lines produced in the warm (300,000 K) intracluster gas in the cooling flow clusters A2597, A2199 and A1795. The existence of this warm component of the ICM has never been detected convincingly, although its presence is expected in the conventional models of cooling flows. These 3 clusters have strong cooling flows derived from their X-ray emission (>100 Msun/yr), as well as strong H-alpha emission from cool (10,000 K) gas in their cluster cores. Detection of the intermediate temperature gas at 300,000 K will provide a strong link between these temperature regimes, and important information on the thermal history of the gas in cooling flows.

Program_ID: P113
Program_title: Circumstellar Interaction in SN 1987A
Program_contact: Sonneborn
Program_abstract: FUV emission from SN 1987A in the Large Magellanic Cloud will be observed to characterize the shock interaction between the high-velocity ejecta and circumstellar gas. We will attempt to observe O VI emission and the full blueward extent of the blue wing of Lyman-alpha, only part of which is observable with STIS because of the high expansion velocity

of the ejecta (V>15,000 km/sec). Emission from recombination lines from the inner circumstellar ring may also be present. The nearest companion star (Star 3) will also be observed.

Program_ID: P114
Program_title: Supernova Remnants
Program_contact: Blair
Program_abstract: The FUSE Team Project on supernova remnants includes an absorption study of the young Type 1a SN remnant SN1006 and studies of selected filamentary emission regions in evolved galactic SNRs. Observations of the "Schweizer-Middleditch" star behind SN1006 will be used to search for a broad absorption from Fe III 1123, using FUSE's high dispersion to resolve contaminating stellar photospheric lines from the broad line. The presence of this line would indicate iron in the cool ejecta of the supernova. Observations of key, well-studied SNR emission filaments will be used to study different kinds of shock wave-ISM interactions, including nonradiative and radiative shocks, and thermally unstable regions. FUSE coverage of a range of ions and ionization stages at high spectral resolution will provide a unique capability to diagnose the thermal, chemical, and kinematic properties of these interactions. Observations of an X-ray bright region will be used to search for faint, high-ionization lines never observed previously in spectra of SNRs.

Program_ID: P115
Program_title: Diffuse Molecular Hydrogen
Program_contact: Shull
Program_abstract: The FUSE PI team will study interstellar H_2 absorption spectra of OB-stars in the Galactic halo, SMC, and LMC. The H_2 lines will be used to derive molecular abundances, the CO/H_2 and HD/H_2 ratios, rotational populations, rotational temperatures, gas densities, and UV radiation field in diffuse clouds. We will measure the molecular abundances, including CO/H_2 and HD/H_2, as a function of metallicity, and estimate the gas pressure (nT) in the low halo. We will also observe H_2 in planetary nebulae toward hot central stars.

Program_ID: P116
Program_title: Molecuar Hydrogen in Translucent Clouds
Program_contact: Snow
Program_abstract: The FUSE PI team will observe 31 stars which lie behind translucent clouds (i.e. clouds having total visual extinctions of around 2 magnitudes or greater), in order to determine the H_2 column densities (for all stars on the list) and the H_2 rotational excitations (for the brighter stars on the list). The total H_2 column densities will be applied to studies of gas-phase depletions and chemistry, while the rotational excitations will be used to analyze the physical conditions (e.g. cloud densities, temperatures, and radiation fields). In addition, the FUSE spectra will be used to determine far-UV extinction curves for the program stars, and data on lines of atoms and ions, as well as molecular transitions of species other than H_2, will be used in a comprehensive analysis of cloud abundances, depletions, and chemistry.

Program_ID: P117

Program_title: Mass Loss and Stellar Winds of Hot Stars

Program_contact: Hutchings

Program_abstract: This program is intended to a) enable modelling of stellar winds from FUSE spectra combined with HST/IUE range spectra, which will yield proper determination of the wind ionization balance. The program stars are selected mainly from the LMC and SMC and will be combined with the Galactic star sample from other programs, to b) enable a comparison of winds in stars with matched spectral type and luminosity in the 3 different environments, since abundance is known to be an important parameter in driving winds. Spectral types range through WR, and O3 to B2. Exposures are designed to provide a minimum S/N of 30 over 0.2 Angstroms; in many cases this is exceeded.

Program_ID: P118

Program_title: Spectroscopic Survey of Cool Stars

Program_contact: Linsky

Program_abstract: This program will obtain far-UV spectra of cool stars that span a broad range of spectral type and luminosity class. It is our intention to obtain these spectra early in the FUSE program and to provide the spectra quickly to the user community in order to guide potential guest investigators in designing their observing programs. The specific science objectives include: (1) studying transition region dynamics (winds and downflows), (2) modeling the thermal structure of transition regions, (3) measuring electron densities, (4) search for low temperature coronae, (5) studying molecular excitation and fluorescence processes, and (6) inferring how the transition regions of spectroscopic binary systems differ from those of single stars.

Program_ID: P119

Program_title: Circumstellar Disks Around Main-Sequence and Pre-Main- Sequence Stars

Program_contact: Vidal-Madjar

Program_abstract: The purpose of this program is to provide new insight on the signatures of circumstellar gas around main-sequence and pre-main-sequence stars. For some stars, the already detected gas may be the by-product of some activity (like evaporation and/or collision of kilometer-sized bodies) in a young planetary system in its clearing out phase. Spectroscopic variations observed around the targets stars (PMS, Herbig AeBe) present strong similarities with the already observed ones, but the origin of the circumstellar gas within these systems is still unclear. Detection of deuterium may help in identifying the origin of the gas. These observations are expected to allow the identification of the main form of the gaseous phase (H_2, CO, OI, NI, CII ?) and provide information on the ionization equilibrium of the zero radial velocity as well as of the accreting gas. Analysis of multiplet ratios will allow to probe the sizes of the inflowing gas structures. Also, in order to better understand the evolution of circumstellar gas from young stellar objects to main sequence stars, a few very young B-type stars are included as being members of a binary system with a T-Tauri companion.

Program_ID: P120
Program_title: FUSE Solar System Studies
Program_contact: Feldman
Program_abstract: H_2 emissions from both Jovian auroral regions measured with the high-throughput aperture (MDRS) will determine temperatures and self-absorption. Atomic H emissions from the bulge region measured by the high resolution aperture (HIRS) will determine the dynamics of the bulge and anti-bulge regions. The high-throughput aperture will be used to search for HD fluorescently pumped by solar Lyman-beta as well as to determine if there is a correlation of the H_2 Lyman and Werner bands with Lyman-alpha in the bulge region. The excitation of H_2 in the atmosphere of Saturn will be similarly studied. Io Torus emissions will be measured using the high-throughput aperture (MDRS) to determine ion velocity profiles and with the large science aperture to search for minor constituents. Observations of Venus will address the question of the atmospheric D/H ratio.

FUSE/Johns Hopkins Univ. Instrument and Operations Team Projects

Program_ID: P131
Program_title: Small-Scale Structure in the ISM
Program_contact: Friedman
Program_abstract: The properties of the interstellar medium on scale sizes of about 1 pc are not well understood. Even as fundamental a parameter as the range of cloud sizes has not been measured properly. Some data suggest only weak opacity variations on scales of ~1 pc, and essentially none below 0.2 pc. Other data, especially in the UV and radio, suggest absorption line equivalent width variations as great as 25-50% toward targets with separations smaller than 3000 AU (~0.01 pc) at a distance of ~200 pc. The goal of this program is to observe closely spaced lines of sight toward spatially adjacent targets in an open cluster (NGC2264, distance=750 pc) in order to measure or place limits on various properties of clouds in the local interstellar medium. Among these properties are the sizes of the clouds and possible anomalous abundances. In addition, these observations may provide measures of metallicity and depletion gradients across the face of the cluster.

Program_ID: P132
Program_title: PG1159 Stars
Program_contact: Kruk
Program_abstract: The hot metal-rich hydrogen-deficient white dwarfs known as PG1159 stars provide a unique probe of the late stages of stellar evolution. Present theories of stellar evolution do not yet produce stars that match the properties of PG1159 stars. FUSE observations will provide improved data on the surface compositions of these stars; in addition, the O VI resonance line profiles will be searched for evidence of ongoing mass-loss. The long exposure on WD2117+341 is used to search for the effects of the pulsations on certain diagnostic line profiles. The 2000s exposure on HS2324 is a snapshot: if the spectrum shows sufficient flux then some time will be reallocated within the program.

Program_ID: P133
Program_title: Planetary Nebulae Central Stars
Program_contact: Bianchi
Program_abstract: Central stars of Planetary Nebulae (CSPN) are among the hottest stars in the H-R diagram. IUE and HST observations show that CSPN have significant supersonic winds and mass loss. Accurate measurements of the wind velocity and mass loss rate in CSPN are a crucial to test of whether current theories of radiation pressure accelerated winds apply to evolved, high gravity stars, and to understand the formation and evolution of the nebular shell, since the photons from the hot central star, and the momentum of its supersonic wind are responsible for the ionization of the visible nebula, and influence the dynamics of the expanding shell. IUE and HST data give only partial information about mass loss, since they can only observe the (often saturated) resonance lines of CIV, SiIV and NV. FUSE can observe wind lines in a greater spread of species and ionization states, especially the hot O VI 1032,1037 doublet, from which the wind ionization can be determined accurately. UV (IUE/HST) and optical spectra are already available for a consistent analysis of photospheric and wind lines. The line profiles will be analyzed with different methods (SEI, SSBAL, EMISSEI) to derive wind velocity, mass loss rate, gravity, temperature and luminosity. Moreover, measurements of the stellar continuum in the FUSE range will yield better determinations of temperature and luminosity, both because of the hot temperatures of the stars, and because nebular continuum emission contaminates the flux of CSPN longwards of about 1400 Angstroms, but drops drastically below 1300 Angstroms. Therefore, FUSE spectra of CSPN can help our understanding of mass loss mechanisms, PN formation and evolution (physical interpretation of the morphology), nebular ionization, and post-AGB evolution.

Program_ID: P134
Program_title: Search for O VI Emission in the Halo of NGC 4631
Program_contact: Murphy
Program_abstract: We propose to look for the O VI 1032/1038 emission lines from hot gas in the disk and halo of the edge-on spiral galaxy NGC 4631. ROSAT observations of NGC 4631 clearly show a concentration of soft X-ray emission north of the galaxy's plane directly above an area of high star formation activity. The X-ray spectrum implies the presence of a soft X-ray gas component at a temperature of less than 1 million degrees. Since O VI is the best diagnostic of gas at this temperature in the FUSE bandpass, our measurements of the O VI emission strength will help us to understand the physical state, total content, and scale height of hot gas in the halo of NGC 4631. These quantities can then be directly compared to values derived for the Milky Way through the O VI Program.

Program_ID: P135
Program_title: Epsilon Aurigae
Program_contact: Ake
Program_abstract: FUSE will be used to study the nature of the unusual eclipsing spectroscopic binary, epsilon Aurigae. The most favored model of this system is that the secondary object is a large, cold disk seen nearly edge-on. IUE and GHRS observations indicate the existence of a far-UV excess compared to other A-F type supergiants, presumably from a hot star in the center of

the disk. The main difficulty in interpreting the UV data is that the primary star still contributes significant flux down to 1400-1500 Angstroms. FUSE observations will perform a more direct examination of the secondary, free from contamination by from the photosphere of the primary star. Measurements will be made to determine the physical parameters of the central star, and study variability and gas motions in the disk.

FUSE/U.C. Berkeley Instrument Team Projects

Program_ID: P151
Program_title: Supernova Remnant Absorption Studies
Program_contact: Welsh
Program_abstract: We will observe 4 early-type stars in the line-of-sight towards the Monoceros Loop supernova remnant in order to investigate the dynamics, ionization state and elemental abundances of the disturbed, absorbing interstellar gas associated with the remnant.

Program_ID: P152
Program_title: Herbig Be stars
Program_contact: Welsh
Program_abstract: We will repeatedly observe 4 early-type Herbig Be stars which are thought to possess gaseous circumstellar disks. Our investigation will focus on the strong stellar FUV line profiles to determine the extent of time variability due to mass loss and accretion processes. We will also analyze the physical state of the molecular absorption lines sampled in the interstellar gas serendipitously observed in the line-of-sight to these objects.

Program_ID: P153
Program_title: Active Late-Type Stars
Program_contact: Griffiths
Program_abstract: We will complete repeated exposures of the active late-type RS CVn stars AR Lac and HR 1099, and perform an extended exposure of the G8V star Xi Boo A. We will obtain a better description of the transition regions of these stars by completing the full emission measure distribution and accurately measuring the plasma electron density. We hope to gain a detailed understanding of the connection between magnetic activity at the photospheric and transition region levels, and will search for solar-like coronal mass streamers using O VI (1032,1038 Angstrom) line profiles.

Program_ID: P154
Program_title: Flare Activity in Cataclysmic Variable Systems
Program_contact: Siegmund
Program_abstract: We will repeatedly observe one pre-CV and one normal CV eclipsing binary system to monitor the level of FUV flare activity that is routinely observed in these systems in other wavelength bands. We will observe the FUV emission from the surrounding gas disk and wind, the white dwarf companion, and a possible hot disk corona produced by EUV/X-ray radiation from the white dwarf that photoionizes and heats the disk surface.

FUSE/Univ. of Colorado Instrument Team Projects

Program_ID: P163
Program_title: T-Tauri Stars
Program_contact: Wilkinson Program Abstract: FUV spectra of pre-main sequence (PMS) stars show high temperature emission lines from magnetically heated regions and excited molecular lines from the circumstellar environment. The FUSE region is still largely unexplored for PMS stars and contains unique diagnostics such as the O VI doublet, H Lyman lines, and the H_2 Lyman bands. Our targets are the Classical T Tauri star T Tau and the Herbig Ae star HD104237. T Tau shows a rich UV spectrum of a wide range of ionic and H_2 lines, while the UV spectrum of HD104237 shows wind-dominated emission lines below 1500 A.

Program_ID: P164
Program_title: Zeta Aurigae Systems
Program_contact: Wilkinson Program Abstract: Zeta Aurigae/VV Cep eclipsing binary systems offer the most detailed method of studying mass loss from cool supergiant stars. The FUV continuum from the hot main-sequence secondary star provides a probe through the outer atmosphere and wind of the evolved primary star. The absorption spectra obtained will allow detailed investigation of the flow properties and ionization structure of these binaries, leading to improved mass-loss rates and wind energy budgets.

Program_ID: P166
Program_title: X-ray Binaries
Program_contact: J. Green
Program_abstract: Observations of bright X-ray binaries will be used to determine the physical conditions in the companion star's wind and the effects of the high energy spectrum on the wind environment.

FUSE Co-Investigator Projects

Program_ID: P179
Program_title: Atmospheres of Cool Star Binaries
Program_contact: Dupree
Program_abstract: The densities, mass motions, and emission measures will be evaluated for a selection of single stars and binary systems containing cool stars with various rotation periods to assess the effects of rotation upon the structure and energy balance of a stellar atmosphere. Most systems will be observed 3 times.

Program_ID: P180
Program_title: Target of Opportunity Observations of Comets
Program_contact: Feldman
Program_abstract: FUSE will attempt to determine the argon/oxygen ratio in a target of opportunity comet whose activity level and orbit are suitable for the observation. In addition, we will search for molecular hydrogen released directly by the cometary nucleus and for neutral

and singly ionized nitrogen. These measurements will be normalized to a water production rate derived from the observed hydrogen Lyman series.

Program_ID: P184
Program_title: Stellar Winds and CVs
Program_contact: Hutchings
Program_abstract: Three stars in M33/M31 will be observed to study their stellar winds. The disk-dominated supersoft binary X-ray source 0513-69 in the LMC will be observed. Three CV binaries will be observed, with readouts at intervals which will sample their orbital and other variations. These targets are highly variable - maximum visible magnitude is given.

Program_ID: P186
Program_title: Transition Regions of PMS and Pleiades-Age Stars
Program_contact: Linsky
Program_abstract: The objectives of this program are to study the dynamics, thermal structure, and energy balance in the transition regions of young stars, including pre-main sequence and Pleiades age stars. The observations will address these questions by measuring the far-UV fluxes, line widths, and Doppler shifts of the O VI and other far-UV transition region lines. We will be studying some young A-type stars to determine whether their transition regions differ from those of cooler stars, and will analyze any flares observed in these young stars and a reference late-M star.

Program_ID: P187
Program_title: Pulsar and CV Observations
Program_contact: Malina
Program_abstract: PSR_0656+14: Measurement of surface thermal emission from neutron stars (NS) is essential to theories regarding the condensed matter state equation, the thermal evolution of NS, and of NS atmospheres. We propose to conduct 50 Ang band FUV photometric observations of PSR B0656+14, an X-ray, SXR and EUV bright isolated NS with an optical counterpart. FUV photometry will provide critical characterization of the NS's surface thermal radiation. Higher energy observations may be effected by poorly established effects including magnetized atmospheres, chemical compositions, temperature gradients and gravitational effects. Optical observations may be subject to non-thermal effects.

V3885 Sgr: V3885 Sgr is one of the brightest nonmagnetic cataclysmic variables. We propose to observe V3885 Sgr for 5 to 6 contiguous FUSE orbits, achieving a S/N of about 12 at full resolution even at the troughs of the source's O VI absorption lines in each spectrum (assuming 2000 sec visibility per orbit). The primary purpose of the observations is to use the source as a bright continuum against which to study local interstellar absorption lines. Although observed on Malina's Co-I Program, the data will be analyzed in collaboration with members of the O VI Project.

Program_ID: P191
Program_title: Lyman Break in Star-forming Galaxies
Program_contact: Shull
Program_abstract: We will observe a blue, metal-poor, star-forming galaxy, Mrk 357 ($z = 0.053$) shortward of its (rest-frame) Lyman limit to measure or set limits on the Lyman continuum escape fraction. This fraction constrains the HI opacity and topology of gas layers in the parent galaxy and its halo, and it gauges the potential contribution of starbursts to the metagalactic (IGM) radiation field. A related goal is to use the spectrum longward of the Lyman limit for better understanding the star, dust and gas content of the galaxy.

Program_ID: P192
Program_title: T Tauri Stars
Program_contact: Siegmund
Program_abstract: We shall observe two relatively unobscured T Tauri stars to investigate the emission from accreting hot gas known to be present in these systems from previous IUE data. Observations of these emission processes will help in understanding the role of circumstellar disk gas in these pre-main sequence systems.

Program_ID: P193
Program_title: Studies of Interstellar and Circumstellar Gas and Dust
Program_contact: Snow
Program_abstract: Studies under this program fall into three distinct categories: (1) a detailed analysis, with enhanced S/N, of the spectra of two stars (HD 24534 = X Persei; and HD 23180 = o Per) for interstellar lines, with emphasis on weak molecular features and lines below 1000 Angstroms; (2) a study of absorption and emission in the spectra of three planetary nebula central stars; and (3) a search for UV diffuse bands as stationary features in the spectra of high-amplitude spectroscopic binaries.

Program_ID: P198
Program_title: Blue Compact Galaxy and CSPN
Program_contact: Vidal-Madjar
Program_abstract: IZW18 is known to be a blue compact galaxy presenting a very low metallicity. The purpose of this investigation is to search for H_2 in the context of such a low metallicity, probably dust free object. A high velocity cloud is also present along this line of sight. These observations will allow the precise evaluation of a much longer exposure to further study both the galaxy and the intervening high velocity cloud. Several programs can also be done simultaneously by observing the central stars of some bright Planetary Nebulae (PN): (a) The wavelength range is particularly appropriate to study the continuum, the temperature and the wind of the PNe central stars; (b) In addition to the stellar continuum, the spectra will yield information concerning the nebula; (c) FUSE will offer the possibility to detect molecular hydrogen lines in absorption against the stellar continuum. It should then be possible to determine how much additional H_2 is formed by shocks in the stellar winds. (d) Finally, the non-detection of deuterium should allow a direct check of its evolution within stars since these PN were selected for their different 3He environment.

FUSE French Guaranteed Time Projects

Program_ID: Q101
Program_title: H_2 Associated with Dust Color Variations
Program_contact: Gry
Program_abstract: We propose to study the H_2 excitation, as well as the H_2 abundance and velocity distribution in nearby diffuse clouds in the Chamaeleon complex. The selected lines of sight present a wide variety in infrared colors, E(B-V), Rv and molecular abundances so that we can check the dependence of H_2 properties with these characteristics. After IRAS data revealed spatial variations in the dust emission color of these clouds, these variations have been correlated with changes in the shape of the UV part of the extinction curve, showing that they are due to variations in the size distribution of small dust particles. Comparative studies in the millimeter, visible and UV ranges have shown that highly energetic processes are present in the cloud presenting mid-IR excess. Magnetohydrodynamic shocks and intermittent dissipation of turbulence have been considered. The proposed study of H_2 in these clouds will help characterize these processes which should be of great significance for the evolution of dust particles and of the gas itself.

Program_ID: Q103
Program_title: He I in Local ISM
Program_contact: Vidal-Madjar
Program_abstract: An attempt will be made on the brightest EUVE source showing emission in the 600 Angstrom EUVE band (410 c/ksec), to try to detect some second order absorption signature corresponding to He I in the local ISM.

Program_ID: Q105
Program_title: Lyman Break in Star-Forming Galaxies
Program_contact: Deharveng
Program_abstract: We wish to observe a star-forming galaxy shortward of its (rest frame) Lyman limit in order to measure or set limits on the Lyman continuum escape fraction. An object with a redshift large enough to get rid of residual galactic gas absorption (lyman series) is selected. Another related goal is to use the spectrum longward of the Lyman limit for better understanding the star, dust and gas content of the galaxy.

Program_ID: Q106
Program_title: O VI Phase in Galactic Haloes
Program_contact: LeBrun
Program_abstract: We propose to make low resolution (R=2000 and S/N~20) observations of two quasars, 3C 351 and Mark 205. Their sightlines cross the near environment of already known and identified galaxies or groups of galaxies, at impact parameters in the range 40-700 kpc (H0 = 50 km/s/Mpc). We will be able to detect the O VI doublet lines in absorption down to a limiting equivalent width of 0.2 Angstrom. We thus plan to determine whether a highly ionized phase exists in the close galactic environment in which the cooler and denser MgII absorbers would be embedded. These observations will also help in determining whether collisional

excitation is present in these clouds and also to study the evolution of the shape and intensity of the intergalactic UV flux at low redshift.

Program_ID: Q107
Program_title: H_2 in the Small Magellanic Cloud
Program_contact: Ferlet
Program_abstract: The star Sk 143 in the SMC has most peculiar properties: its extinction curve in the far-UV is of Galactic type, contrary to all the other SMC stars which have a small or absent extinction bump and a very strong rise in the extinction at shorter wavelength. It also has an apparently Galactic ratio of E(B-V) to atomic hydrogen column density. Still, the interstellar lines are at the SMC velocity, and suggest that the extinction is due to a molecular cloud in the SMC. However a deep integration in the CO(1-0) line with the Swedish-ESO submillimeter telescope has given a null result. FUSE will help solve this mystery by observing the H_2 lines and other lines which might yield a detection of the absorbing gas.

Program_ID: Q108
Program_title: Central Stars of Planetary Nebulae
Program_contact: Vidal-Madjar
Program_abstract: Several investigations will be done simultaneously by observing the central stars of some bright Planetary Nebulae (PN): (a)The wavelength range is particularly appropriate to study the continuum, the temperature and the wind of the PNe central stars; (b)In addition to the stellar continuum, the spectra will yield information concerning the nebula. The CIII line at 977A should be easily observable. Its intensity will be an additional independent measurement to resolve the controversy about the carbon abundance in PN; (c)FUSE will offer the possibility to detect molecular hydrogen lines in absorption against the stellar continuum. In several cases, the velocity separation of that component formed in the vicinity of the nebula and that formed in the general ISM will be possible. It should then be possible to determine how much additionnal H_2 is formed by shocks in the stellar winds. (d)Finally, the non detection of deuterium should allow a direct check of its evolution within stars since these PN were selected for their different 3He environment.

Program_ID: Q109
Program_title: Peculiar White Dwarfs
Program_contact: Vidal-Madjar
Program_abstract: The standard post-AGB evolution theory predicts that throughout the whole post-AGB phases the chemical surface composition of the star remains essentially unchanged, because hydrogen shell burning ceases when the surface H-rich layer has been thinned down to about 1.e-4 Msun. However about 25% of the spectroscopically observed post-AGB stars in the planetary nebula stage are hydrogen-deficient and the origin of their peculiar surface abundances is still unclear. Among the hydrogen deficient post-AGB stars the class of the PG1159 stars are the most peculiar. They cover the hottest part of the post-AGB evolution (65000 - 180000K) and their surface is composed of carbon, helium, and oxygen (typically 50/30/20% by mass). Since mass loss could also be responsible for the observed peculiarities, we need a determination of the mass-loss rate to be conclusive. The O VI line at 1034 Angstroms is

best suited since it is the most sensitive indicator for mass-loss in these stars. In that frame we will observe PG1159-035 the prototype as well as H1504+65 which is the most extreme one of this class. Deuterium evaluations will be also made on the line of sights towards these stars.

Program_ID: Q110
Program_title: Quasi-Molecular Satellite Lines in Lyman Beta
Program_contact: Vidal-Madjar
Program_abstract: Our purpose is to detect in the wing of Lyman Beta the signatures of absorptions due to the quasimolecular satellites of H_2+ and H_2 in, respectively, photospheric spectra of a white dwarf and a Lambda Boo star where they have been observed in wing of Lyman Alpha. These targets are suitable for such detection: the white dwarf WD1620-391 has a pure hydrogen atmosphere and that of HD125162 is depleted in metals.

Program_ID: Q111
Program_title: The Symbiotic Binary IX Velorum
Program_contact: Ferlet
Program_abstract: The profiles of the absorption and emission lines, particularly of the O VI doublet for the symbiotic binary AG Peg, will enable information to be obtained on the kinematics of the regions of line formation. The very high ionization O VI doublet may in particular be produced very near the compact hot component. A wind from the cool component of the binary should be present; signs of the continuing existence of a wind from the hot component seen on older IUE spectra as well as a possible region where the winds collide, will be looked for.

Program_ID: Q112
Program_title: Cataclysmic Binaries
Program_contact: Ferlet
Program_abstract: We propose to observe the highly mass-accreting cataclysmic binary IX Vel in the far UV, for the first time at a very high spectral resolution (R~30000), to infer the physics of the accretion very close to the white dwarf. A detailed analysis of the absorption resonance lines of O VI, PV and SVI by means of phase-resolved spectra (exposure time of 1/8 Porbital) will bring important clues to probe the structure of the wind (geometry, velocity law, inhomogeneities). When combined with the study of the continuum distribution in the far UV, this will allow us to test the still unknown mechanism of wind formation and to distinguish between different proposed models for the boundary layer which plays a major role in the dynamical evolution of these systems.

Program_ID: Q113
Program_title: The Old Nova V603 Aql
Program_contact: Ferlet
Program_abstract: The absorption and emission line profiles of the old nova V603 Aql will be observed with FUSE in order to further study the properties of what appear to be an accretion disk and wind coming from this disk, also studied at longer wavelengths. Rapid line profile

variations already seen for other lines in HST spectra, will in be searched for and examined, this being the case in particular for the O VI doublet.

Program_ID: Q114
Program_title: Be Stars
Program_contact: Ferlet
Program_abstract: The study of high excitation line transitions in the wavelength range observed by FUSE will bring important information on the nature of activities taking place in the outermost layers of Be stars. The Lyman energy distribution predicted by thermal models of stellar atmospheres, which does not even agree with observations of normal B stars, will probably produce larger disagreements in Be stars, where, as highly rotating objects, the atmospheric structure remains quite unknown. A young B star in a binary system with a T-Tauri star will also be observed for the purpose of comparison. This program is also conducted in the frame of other observing programs toward B and Be stars.

Program_ID: Q119
Program_title: Circumstellar Disks
Program_contact: Deleuil
Program_abstract: The purpose of this program is to give new insights on the signatures of circumstellar gas around main-sequence and pre-main-sequence stars. For the stars Beta Pic (HD39060) and 51 Oph (HD158643), the gas already detected may be the by-product of some activity (like evaporation and/or collision of kilometer-sized bodies) in a young planetary system in its clearing out phase. These observations are expected to allow the identification of the main form of the gaseous phase (H_2, CO, OI, NI, CII ?) and to give information on the ionization equilibrium of the zero radial velocity as well as accreting gas. Analysis of multiplet ratios will allow to probe the sizes of the inflowing gas structures.

CERTIFICATION REGARDING DRUG-FREE WORKPLACE REQUIREMENTS

This certification is required by the regulations implementing the Drug-Free Workplace Act of 1988, 34 CFR Part 85. Subpart F. The regulations, published in the January 31, 1989 Federal Register, require certification by grantees, prior to award, that they will maintain a drug-free workplace. The certification set out below is a material representation of fact upon which reliance will be placed when the agency determines to award the grant. False certification or violation of the certification shall be grounds for suspension of payments, suspension or termination of grants, or government-wide suspension or debarment (see 34 CFR Part 85, Sections 85.615 and 85.620).

I. GRANTEES OTHER THAN INDIVIDUALS

A. The grantee certifies that it will provide a drug-free workplace by:

- (a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
- (b) Establishing a drug-free awareness program to inform employees about --
  - (1) The dangers of drug abuse in the workplace;
  - (2) The grantees policy of maintaining a drug-free workplace;
  - (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
  - (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
- (c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
- (d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will
  - (1) Abide by the terms of the statement; and
  - (2) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five days after such conviction;
- (e) Notifying the agency within ten days after receiving notice under subparagraph (d) (2) from an employee or otherwise receiving actual notice of such conviction;
- (f) Taking one of the following actions, within 30 days of receiving notice under subparagraph (d) (2), with respect to any employee who is so convicted --
  - (1) Taking appropriate personnel action against such an employee, up to and including termination; or
  - (2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or Local health, Law enforcement, or other appropriate agency;
- (g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e), and (f)

B. The grantee shall insert in the space provided below the site(s) for the performance or work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

____
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Check _____ if there are workplaces on file that are not identified here.

II. GRANTEES WHO ARE INDIVIDUALS

The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance in conducting any activity with the grant.

Organization Name	AO or NRA Number and Title
Printed Name and Title of Authorized Representative	
Signature	Date
Printed Principal Investigator Name	Proposal Title

CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
PRIMARY COVERED TRANSACTIONS

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 14 CFR Part 1265.

A. The applicant certifies that it and its principals:

   (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

   (b) Have not within a three-year period preceding this application been convicted or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

   (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification;

   (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lowered Tier Covered Transactions (Subgrants or Subcontracts)

   (a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.

   (b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name AO or NRA Number and Title

Printed Name and Title of Authorized Representative

Signature Date

Printed Principal Investigator Name Proposal Title

Certification Regarding Lobbying

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000, and not more than $100,000 for each such failure.

Organization Name AO or NRA Number and Title

Printed Name and Title of Authorized Representative

Signature Date

Printed Principal Investigator Name Proposal Title